THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE ELECTRIFICATION OF RAILWAYS.

THE recently-published report of Mr. C. H. Merz on the electrification of the Melbourne railways, together with the announcement of the extensive schemes of conversion to electrical operation of the L. & N.W. and the L. & S.W. Railways, may reasonably be regarded as evidence that at last the long-expected, but long-delayed, period of activity in this important department of electrical engineering is about to open. In saying this we do not ignore the fact that the great system of the London underground railways, and a large portion of the L.B. & S.C. Railway, as well as other lines, have already been converted to electrical working; but these operations were somewhat exceptional in character, the former having been effected practically under Parliamentary compulsion, and the latter under pressure of intense competition which had destroyed the profit-earning power of the sections concerned, so long as they were operated with steam locomotives. The three examples which are now before us stand on an entirely different footing; they embody the conviction of their respective directorates that the future of suburban railway traction depends upon the adoption of electricity as the motive power, and that no other agency can cope with the growing demands for transport facilities in and around our great centres of population.

That their example will be followed by other railway companies in London, Manchester and elsewhere, can hardly be doubted, and the extension of the principle to interurban traffic may be confidently expected to follow at no distant date; between London and Brighton, Manchester and Liverpool, Edinburgh and Glasgow, and various other neighbouring towns the need for rapid transit and convenience of operation, such as only electricity can supply, is little less urgent than in the areas immediately surrounding those centres. We anticipate, therefore, a period of great activity in the manufacture of the necessary plant and equipment, which, we hope, will bring to the electrical industry in this country that degree of prosperity which we believe it thoroughly deserves, but has never hitherto enjoyed.

The question inevitably arises here to what extent our manufacturers will participate in the important orders shortly to be placed. So far as the generating, transmitting and converting apparatus is concerned, we believe they are in a position to defy the competition of the world; but as regards the equipment of the rolling stock, the position is not so clear. The enormous importance of this part of the work is well exemplified by Mr. Merz's report, according to which the cost of equipping the 500 motor-coaches and 450 trailers on the D.C. system is nearly a million sterling, and on the A.C. system almost two millions. So long as the work is carried out on the D.C. system, whether at 1,500 volts as at Melbourne, or at 600 volts as in the other two schemes before us, our manufacturers can be relied upon to deal with the work without any difficulty; but if the A.C. system

were adopted, as has been so largely the case on the Continent, our people might be at a disadvantage owing to their limited experience in this class of work. It is, therefore, a matter for congratulation from a commercial point of view that these three systems will all be carried out on the D.C. system.

We cannot here enter into the question of the respective merits of the D.C. and A.C. systems—the subject calls for an article to itself, and must be left to another occasion—but we may point out the importance of preparation for the execution of contracts on the A.C. system, which will almost certainly be employed in some cases; we trust that British manufacturers will take care to provide themselves with the information and experience necessary to enable them to undertake the equipment of motor cars on the single-phase system in any part of the world where they may be required.

Elsewhere in this issue we refer in some detail to the two London schemes of railway electrification, no less important in view of the magnitude of the interests involved than the Melbourne project, and undoubtedly of much closer interest to the majority of our readers. These are the London and North-Western and London and South-Western schemes, the former of which contemplates the equipment of 79 miles, and the latter of 73 miles (increased eventually to 173) of single track.

In both these cases it is reasonable to assume that inter-running facilities with existing electric railways influenced the decision in favour of the 600-volt third-rail system. To adopt any other system would mean voluntarily relinquishing the undoubted advantages of possible through services into the heart of the metropolis, and of utilising the existing termini—or, in the alternative, complicating the electrical equipment and running of the trains if both third-rail and overhead working were involved.

In both the North-Western and South-Western schemes a 25,000-KW. power station is proposed, and one begins to wonder how many more of these not really large, yet not small, railway power plants will be installed in London, which already suffers from a surfeit of comparatively insignificant generating stations. One independent 25,000-KW. power station could not very well contain less than five units (and judging from past experience, some engineers would prefer twenty-five), thus limiting the unit size to at most 5,000 KW., yet it seems passing strange in these days of 150,000-volt transmissions and 20,000-KW. turbine units, that some combined scheme for the production of railway power on a genuinely economical scale—a magnified Lot's Road station, for example, with 15,000 or 20,000-KW. turbines—has not been arranged.

If it is advantageous to do away with small scattered power units—in this case steam locomotives—and concentrate power production in one plant, it would seem only reasonable to carry that concentration to the fullest extent possible, and reap the huge monetary economy which the largest present-day unit is capable of showing. Moreover, as both the Lot's Road and Neasden plants are near and could render help in emergency in the case of a joint power scheme, an appreciable saving in spare plant and capital cost would result.

LABOUR RUN RIOT.

We have had occasion more than once in these columns to inveigh against the methods of the Neo-Trade Unionist. Not content with striking for higher wages and shorter hours, he has invented all kinds of other excuses for industrial warfare, whereby he hopes eventually to bring employers of every class under the heel of the proletariat. We are far from saying that a strike is always unjustifiable and illegal; but, to use a cant phrase, the claims of those who leave work without notice to their employers appear to have reached "the limit" in the strike on the North-Eastern Railway.

An experienced engine driver was convicted of being drunk while off duty. The company, in the faithful discharge of its duty to the travelling public, lowered his status to that of pilot engine driver. Immediately, and without any notice, some thousands of his friends leave work, with the result that traffic on an important railway is dislocated, and many thousand passengers and traders are condemned to suffer loss and inconvenience.

The justification of the railway managers is complete in the eyes of all ordinary men and women. Each engine driver is entrusted with the lives of hundreds of thousands in the course of the year. To allow them to be at the tender mercies of a man who is known to give way to drink were little short of criminal. Suppose, for instance, a frightful accident were to take place on the North-Eastern, or any other railway, and it was revealed at the inquest that, to the knowledge of the company, the driver had been convicted of drunkenness a few weeks before—what would be the defence of the directors before the Coroner's jury? What would they be able to say in mitigation of their crass neglect before that larger and more critical jury—the British Public? These two questions have only to be put in order to supply a complete vindication of the step taken by Mr. Butterworth, which has brought about the present strike.

That the example of striking against the ordinary rules of discipline which are observed in every well-conducted business should be set on the North-East coast is not surprising. For some reason which is hard to explain, workers in this corner of England have always seemed to be the advanced guard in the army of militant Trade Unionists. In 1909 a dispute was referred, by the consent of masters and men, to the arbitration of Sir James Woodhouse. The award was given in November of that year. The men did not get all they wanted. Then, without the usual notice of an industrial war, they struck to set aside an award by which, as one of the parties to the dispute, they had agreed to abide. But the mere breaking of agreements is apparently not enough to satisfy these men. They must needs lay it down that sobriety is not to be considered a qualification for the highest and most responsible post which falls to the lot of a railway servant.

It is difficult to say where this latest labour development will end if it is not checked at once by firm and resolute action on the part of the employers who are involved in this particular dispute.

Readers of this journal would not contemplate with equanimity the spread of this kind of interference to the electrical industry. The difficulties of the manager of an electrical undertaking, either public or industrial, would be increased tenfold if labour, organised or unorganised, were to be considered entitled to interfere in the smallest degree in any question of discipline. As a matter of fact, the men have come out without the authority of their Unions. As we go to press it is stated that the Home Secretary is considering the case of the driver in question, who declares that he was wrongfully convicted. We hope

that the Government will not show any signs of weakness in this matter, but will limit itself to its legitimate duty of settling whether the conviction of drunkenness was or was not justified. Anything beyond that, merely in order to bring "peace at any price," would be an everlasting danger. Too often in the past have we experienced Government intervention. It has always been loudly proclaimed as impartial; but the events of the last few years hardly justify the claim to impartiality. Under one pretext or another, the employers have been compelled to give way; and it is not a large inference to assume that the prospect of official support has done much to strengthen the hands of the strikers.

Business-Getting in the States.

Unity of purpose has never been a strong point with British electrical interests; it is, however, otherwise in the States, where, although it is not suggested that entirely harmonious relations exist between the various partners engaged in the electrical business, yet local jealousies have been subordinated sufficiently to enable the various interests to make common cause for the good of the whole. Thus one notices that the by-laws approved recently by the Society for Electrical Development, Inc., at New York, include an article bearing on the financing of the Society, the funds of which will be subscribed on the following basis:—

Central station and manufacturing members, not less than one-fifteenth of 1 per cent. on the gross amount of their respective sales up to and including $20,000,000, and at the rate of not less than one-twentieth of 1 per cent. on the gross amount of such sales in excess of $20,000,000; the contracting, dealing and jobbing members, not less than one-twentieth of 1 per cent. on the gross amount of their respective sales.

The board of directors will be composed of five classes (the board having 20 members), four from the central station interests, four from the manufacturing interests, four from the jobbing interests, four from the contracting interests, and four at large. These directors will each be elected by the membership represented in the class in which they belong, with the exception of the members at large, who will be elected by the membership as a whole.

The doings of the Society have, of course, attracted attention in this country, but, so far, nothing definite has been accomplished here on similar lines.

Another instance of the wide-awake methods of our American electrical friends is the national co-operative advertising campaign of the Electrical Vehicle Association of America, which, with a view to pushing the electrical vehicle—an entirely neglected vehicle on this side of the Atlantic, although conditions are even more favourable to its use than in the States—called for subscriptions from its members for the purpose of an educational campaign, and secured over $40,000. In this case the subscribers included 81 central stations, seven battery and accessory manufacturers, and 13 vehicle makers; the advertising scheme was entrusted to a recognised agency, and the results are evidently considered satisfactory, as a $50,000 fund is to be formed to continue the campaign for a second year.

The report of the Publicity Committee of this Association discloses an enthusiasm which is infectious; it impresses one with the belief that American electrical men are convinced that judicious expenditure on organised lines is undoubtedly a paying investment; but their *confrères* in this country appear to regard expenditure of this kind as in the nature of a charitable contribution.

Exit the "Greenwich" Engines.

Six-and-a-half years ago the Greenwich tramways generating station of the London County Council was declared open with the usual flourish of trumpets. Some there were who felt that the flourish was not wholly appropriate to the occasion, which will be remembered as marking the introduction into this country of the large low-speed engine of the vertical-horizontal reciprocating type for electrical generating purposes, and that at a time when the steam turbine had already proved its commercial superiority in every way as a prime mover for large generators. At the time we drew attention to the retrograde character of the step which had been taken, and it is, therefore, not surprising to us to learn that these huge machines, excellent examples of engineering skill though they be—which, during their brief existence of 6½ years, have more often than not acted the part of understudy to the commercially more efficient turbine plant which was installed when the second portion of the Greenwich station was constructed—are to be replaced by turbine-driven plant.

Full justification for this step, which accords with our originally expressed opinion on the matter, is contained in the report of the Highways Committee, which shows that it is proposed to substitute in the first instance two 8,000-kw. turbines in the space occupied by two of the 3,500-kw. reciprocating plants, showing a clear gain of 9,000 kw. in generating capacity and an estimated annual saving of nearly £16,000 with coal at its present price, and with the present maximum output. At a later stage the remaining engines will be replaced by two similar turbine units, and the normal capacity of the Council's Greenwich plant will then be 52,000 kw., which, though it represents a limit imposed by the adjacent Observatory authorities, allows a big margin over the present plant capacity of 34,000 kw., and will enable the rapidly increasing load due to tramways extensions to be dealt with economically.

Although unsuited to their present environment even from the day when they commenced to turn round, these huge reciprocating sets, with their double h.p. and l.p. Corliss cylinders and speed of 94 r.p.m., must have many years of useful work before them in some situation where space and fuel cost are subsidiary factors, and an undoubtedly well-built prime mover at a second-hand price is regarded as a consideration.

Swiss Railway Conversion.

The fourth and concluding report has been issued by the Commission of Inquiry which was appointed by the General Administration of the Swiss Federal Railways, to undertake preliminary labours in connection with the suggested conversion of the Swiss railways to electric traction. It appears that the further investigation made has confirmed the opinion of the Commission that the single-phase system of about 15 periods, with a working conductor pressure of 15,000 volts, is the best for the conditions appertaining to State Railways, and also with special regard to the St. Gothard Railway. The scheme prepared for the latter shows that even on the basis of the present prices of coal, electrical working would be considerably cheaper than steam traction, notwithstanding the much higher speeds in the case of the former method, and apart from the advantages of smokelessness and the possibility of being able to utilise the railway to better advantage. The question of the power requirements for all the Swiss railways has also been examined by the Commission. It is calculated that the five networks of State railways and the private railways would annually require, with traffic of twice the volume of that which obtained in 1904, from 1,200,000,000 to 1,300,000,000 h.p.-hours at the turbines, and the hydro-electric works would have to be built for a maximum output of 500,000 h.p. According to expert estimates, the water powers reserved for the State railways could yield 1,800,000,000 h.p.-hours per annum, and the works could be erected so as to be able to produce 625,000 h.p., thus leaving a large amount of power available for industrial purposes.

THE MEASUREMENT OF MAGNETIC FIELDS.

By P. H. S. KEMPTON, B.Sc.

The strength of a magnetic field is defined fundamentally in terms of the force exerted on a hypothetical unit magnetic pole, but Faraday's conception of lines of force provides the unit in terms of which magnetic field strengths are stated in practice.

The statement that a unit pole placed at a point in a magnetic field experiences a force of x dynes is equivalent to the more practical statement that the field has a flux density of x lines per square centimetre or x gausses at that point.

The strength of a magnetic field is measured by the magnitude of its effects. These effects may be divided into three classes, viz., magnetic, electrical and optical, and the applications of these phenomena to the measurement of fields of various strengths and under various conditions will be dealt with in detail under these three headings.

1. *Magnetic Methods.*—The magnetic methods of estimating field strengths are chiefly applicable to fields of small intensity such as that due to the earth.

(*a*) The magnetometric experiments involving observations of deflections and oscillations of magnetic needles are familiar laboratory routine, but are not applicable to the measurement of fields such as are dealt with in electrical machinery and electro-magnets.

(*b*) A method which depends upon the variation of pressure at right angles to the lines of force with the permeability of the medium is, however, of value for fields of great intensity. The method was first used by Quinke to investigate the magnetic properties of liquids, but was modified by Du Bois to measure the strength of fields.

Fig. 1 is intended to illustrate the principle of the method, the actual apparatus being of a slightly more complicated nature. A is a V tube containing a liquid of known permeability (Du Bois used nickel sulphate and water). A magnetic field is applied to the narrower limb, so that the lines of force pass parallel to the liquid surface, some in the liquid and some above it. The pressure at right-angles to the lines of force, and hence at right-angles to the surface of the liquid, is $\mu\ H^2/8\pi$ in the liquid and $H^2/8\pi$ in the air above. The difference of pressure $(\mu - 1)\ H^2/8\pi$ causes the liquid to rise in the narrow limb until equilibrium is established—*i.e.*, when $(\mu-1)\ H^2/8\pi = h\rho g$. By tilting the tube as shown in fig. 1 and reading the elevation of the column by means of a microscope, Du Bois rendered this apparatus more sensitive and capable of measuring fields of strengths from 500 to 10,000 gausses, with an error of less than half of 1 per cent.

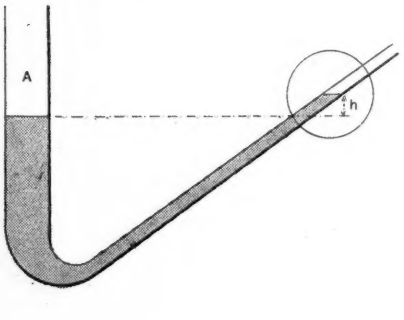

Fig. 1.

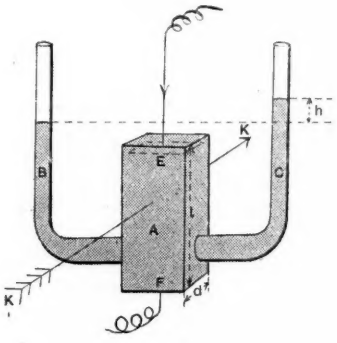

Fig. 2.

2. *Electrical Methods.*—There are three electromagnetic effects which have been used to measure magnetic fields.

(*a*) The induction of current in a conductor moving in a magnetic field. This is obviously the principle of the earth inductor, which, in conjunction with a ballistic galvanometer, provides the most common method for comparing fields such as V and H, and by calibrating the ballistic galvanometer this instrument is rendered capable of giving accurate values of field strengths of small magnitude.

In order to measure strong fields existing in small gaps in electrical machines, &c., the earth inductor is replaced by a small search coil of known effective area connected to a ballistic galvanometer, of which the constant is known, or, more conveniently, to a fluxmeter giving direct readings of flux linkages. The introduction or withdrawal of the search coil changes the linkages by $H \times A$, where H is the magnetic field strength and A the effective area of the coil.

The search-coil method is applicable to fields of all strengths, the sensitiveness being dependent on the effective area of the coil. The coil can be wound on a small flat bobbin in order to facilitate its introduction into narrow gaps, and if a fluxmeter is used there are no troublesome calculations. These advantages probably render this method the most convenient for general practical use.

(*b*) The motion of a conductor carrying a current in a magnetic field. The moving-coil galvanometer may be cited as a simple example of this general principle as applied to the measurement of a current, using a constant magnetic field. A similar apparatus could evidently be used to measure magnetic fields, using a constant current in the coil. The motion of the coil may be measured either by its deflection or by means of a torsion head. Such an instrument for use in small gaps has been devised by Stansfield and Edser. The motion of the coil is determined by the current passing and the intensity of the field. It is measured by means of a torsion head. The constant current (about $\frac{1}{10}$ ampere) is supplied by a portable cell, and a commutator is also provided in order to obtain readings on the torsion head on both sides of the zero.

The force exerted by a magnetic field of strength H on a conductor of length L carrying a current of C C.G.S. units is given by the product H C L. The application of this principle to the case of a liquid conductor provides a further method of accurately measuring large magnetic fields. The apparatus is known as Lippmann's galvanometer, and is shown diagrammatically in fig. 2. The central rectangular cistern A is connected to side tubes B and C; all contain mercury. Current is led in at the top of A by an electrode E, and passes out at F.

The magnetic field is applied across the cistern, as shown by the arrows K K. The resulting force on the conducting fluid (H L C) is transmitted to the side tubes, and the mercury rises in one of them until equilibrium is reached, *i.e.*, when $H\ L\ C = h\ \rho\ g\ \delta L$; ρ being the density of mercury, g the gravitational acceleration, and δ L the section of the mercury perpendicular to the magnetic field.

(*c*) The variation of electrical resistance with magnetic field intensity. This phenomenon occurs to some slight extent in all conductors, and is probably allied to the Hall effect in which the equipotential stream lines are deflected. In bismuth the effect is very marked, the resistance rising rapidly and regularly with field strength.

If a coil of fine pure bismuth wire be used as a resistance it serves to measure fields after having once been calibrated. It is found that R_x/R_0 and H are connected by an approximately linear law over a large range of H. The coil must be of pure bismuth, or this relation does not hold. It must also be wound non-inductively.

Unfortunately, the effects of temperature change are very large in the case of bismuth coils, and so the accuracy of the method often suffers on this account. There is also a time lag, although no trace of hysteresis has yet been discovered.

3. *Optical Method.*—Although magneto-optics provides a multitude of examples of magnetic effects on light phenomena, only one of these has been found of service in the measurement of magnetic field strengths, viz., the magnetic effect on the plane of polarisation. When plane polarised light passes along the direction of a magnetic field the plane of polarisation is rotated through an angle $\theta = C\ H$ where C, the constant multiplier of the field strength, is known as Verdet's constant. This fact has been used in special cases

to measure magnetic fields, but the application of such a method in practice is obviously limited.

Summing up, we find that the electromagnetic effects are the most fruitful of practical methods for measuring magnetic fields of all strengths, and that the search coil and bismuth coil are the most likely to serve practical purposes satisfactorily. The latter has numerous disadvantages compared with the former, and is incapable of high accuracy under ordinary workshop conditions. The magnetic effects provide general methods for the measurement and comparison of weak fields, and one method of importance for strong fields. The use of the optical method is limited to special investigations.

In the above discussion of the various methods we have considered their application to the measurement of steady fields only, that is, fields of which the intensity remains constant during a period of time sufficient for the taking of a normal set of observations. The measurement of fields of rapidly varying intensity, and of the rotating fields in modern A.C. machines, presents some features which deserve attention.

In the first place, methods which are subject to time lag or hysteresis are obviously unsuitable for such measurements. On this account the bismuth coil method, which would afford a direct record of the magnetic field variation on a recording galvanometer, has to be rejected. Du Bois's method and the Lippmann galvanometer suffer from a similar disability—the inertia of the fluid index and the difficulty of accurately recording the motion.

No such objections apply to the search-coil method, but, if this be adopted, the electrical arrangements and the capability of the fluxmeter of quickly following the flux variation become matters of primary importance. It should be possible to design an arrangement of this type with a recording mirror fluxmeter capable of investigating rapid changes of flux density.

Although the optical investigation of field intensity is unlikely to become of importance in workshop practice, the applications of optics to magnetic investigations in the laboratory bid fair to yield valuable results. The change of plane of polarisation with magnetic field intensity may be observed and measured in various ways, and affords a sensitive index devoid of time-lag, hysteresis or inertia defects.

THE JOHANNESBURG TURBINES.

OUR readers will recall that on May 31st of this year we published an article* giving an account of the purchase of steam plant by the Municipality of Johannesburg since 1907, when the gas engines failed. We summed up the results of an inquiry held by Mr. John H. Rider and Mr. A. M. Tippett, into the circumstances attending the submission of, and reporting upon, tenders for a 3,000-KW. alternator during last year. These gentlemen, called the Board of Inquiry, presented their report, and the town clerk of Johannesburg (Mr. John Taylor) presented the board's report, together with criticisms of his own, to the Council.

We expressed very strong views on this course of action, and we did so because we felt, and still feel, that for a layman to criticise the report of a board of experts on a matter of this kind, where they were specially instructed, in a letter under the town clerk's hand, "to report to the Council as to which is the most advantageous tender for the Council to accept," was a highly unwise proceeding. They were not instructed to report to the town clerk, and the town clerk was not instructed to report to the Council. Yet he treated the board's report as matter for a report of his own. It is not material that it was the town clerk who did so. Had it been the Governor of the Union of South Africa, we should still have considered it objectionable.

Our readers will not need to be told that we had no personal feeling in the matter. We did not even know the name of the town clerk. In this matter, we considered that, as a public officer, he had committed a most serious error of judgment, and that, in effect, is what we said in our article.

The sequel to the events thus briefly summarised was a libel action on the part of the town clerk against the *Rand Daily Mail*. In opening the case, Dr. Krause, counsel for the plaintiff, stated that "very serious statements" had been made by members of the Town Council, and it had been suggested that the action of the Town Council was not above suspicion. On June 13th one of the Councillors "made very serious statements," and on June 14th those statements were published in defendant's paper, as well as with other statements, suggesting bribery and corruption. Afterwards the *Rand Daily Mail*, on June 21st, published our article, and considerable flutter in the dovecotes of Johannesburg was caused thereby. The town clerk sued the *Mail* for £1,000 damages, and the action was commenced on October 28th, before Mr. Justice Ward. Eminent counsel appeared on either side, and the case occupied three days. There was also an action in which the town clerk sued Mr. Rider for £1,000 damages on account of the fact that he was alleged to have published the libel by sending a copy of the ELECTRICAL REVIEW for May 31st to Mr. H. J. Hofmeyr, a member of the Town Council.

The defendant newspaper denied that the plaintiff was asked to report upon the matter, but admitted the publication of the words. It was denied that the article was published falsely or maliciously, or that it was defamatory. Alternatively, it was pleaded that the allegations of fact were true, and were justified as expressions of opinion and fair comment made in good faith and without malice on matters of public interest.

Counsel for the plaintiff, in opening, admitted that the dates and general facts concerning the tenders, as stated in the article, were "more or less correct"; and after he (counsel) had read the article and had made sundry statements amplifying to some extent the information available, Mr. John Taylor went into the witness-box.

His examination-in-chief was directed towards proving the facts surrounding the various purchases of steam plant by the municipality. This, and his cross-examination, occupied the whole of the first day, and most of the morning of the second day. During cross-examination Mr. Taylor was on three occasions reduced to silence, failing to answer the questions put to him. Much use was made of the word "bumptious" (which is, with one exception, consistently spelt "bumptuous" in the reports which we have before us, from the *Rand Daily Mail*). The dictionary defines the meaning of the word as "offensively self-assertive," and we applied it to the report of the town clerk. Mr. Rider was certainly offended by that report, and Mr. Taylor, in reply to the question "You have first sat in judgment?" said, "I have had my say, certainly." Hence the word seems highly appropriate.

The next witness was Mr. L. E. Neame, acting editor of the *Rand Daily Mail*, whose evidence dealt with the publication of the article in question, together with a leader dealing with it.

He was followed by Mr. Rider, who gave evidence supporting his report; and the last witness was Mr. Tippett, who was only called for the purpose of speaking as to the circumstances under which he was appointed. The case for the defence was then closed.

Counsel for the plaintiff then began his argument, and went on the lines that because Messrs. Rider and Tippett's report was characterised in the article as "frank, fearless and reliable," the suggestion was that Mr. Taylor's report was none of these things. Of course it was not said or implied that this was the case. His report was frank. So far from being the reverse of fearless, we think it was very daring. It could not be reliable, because, as he admitted over and over again, he was not qualified to pronounce on technical subjects. There is nothing disrespectful in this statement, but the fact is that Mr. Taylor is a solicitor, and not an engineer. The reference to iniquitous conduct on the part of the representatives of the public interest does not involve the town clerk, who is a servant of those representatives.

Counsel for the defence began his argument on the third day. He pointed out that there was no imputation against the plaintiff, but that the main attack was directed against the tactics of the Council.

In the second case—that against Mr. Rider—Mr. Hofmeyr was called to prove that he had received from Mr. Rider a copy of the ELECTRICAL REVIEW containing

* "In Darkest Africa," Vol. 70, page 881.

the article complained of. Mr. Rider also gave evidence, and argument followed. His counsel described the action as one of the most paltry ever heard in court; and the opposing argument was that, by sending the copy, Mr. Rider had made an attempt to discredit the town clerk in the eyes of one of his employers.

Judgment was reserved. On receipt of copies of the *Rand Daily Mail* recently, containing an exhaustive account of the proceedings, we cabled to Johannesburg to ascertain the results of the actions. Our information is that a verdict has been given against the paper for £150 damages, with High Court costs in addition, and against Mr. Rider for £5, with costs in the magistrates' court.

We have already given our opinion on the proceedings leading up to the action, and in what has been written above we have tried, as reasonably as possible, to discuss the action itself, and have given the result of it. The tender of Messrs. Reunert & Lenz was eventually accepted by the Town Council, and we are bound to say that, in view of the whole circumstances, we have nothing to add to, and nothing to withdraw from, our previous article. There is no doubt that our readers will agree, and the British public will hold the same view, that when a municipality invites expert opinion, expressly stating, through its executive officer, that that opinion will practically govern its decision, and then flies in the face of that opinion, adverse comment will be forthcoming, and will appear to be abundantly justified.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Cayley-Robinson Furnace.

A reference to the Cayley-Robinson furnace is made in the ELECTRICAL REVIEW, page 908, as an example of a furnace using steam economically. This remarkable little furnace uses a very slight jet of steam in order to keep in movement a column of furnace gas. The writer claims that steam jets for draught production are never really economical. They serve a good purpose in many cases, and help to effect certain commercial economies. Cheap, dusty and dirty coal is sold at much less per heat unit than good clean coal. Such dirty coal will raise so much more steam for a penny than can be raised by cleaner coal, that some of the extra steam produced can be used to blow the fire, and economy will still be shown. But this does not prove the steam jet to be economical. It is convenient; it serves to eliminate other systems of blowing the fires.

In the Cayley-Robinson furnace the steam jet is a very small affair in a small furnace, and to substitute an air jet, however produced, would involve such mechanical complication, that it would not be a commercial economy. Moreover, an air jet would introduce too much air into the furnace. It appears to be probable that the steam jet in the Cayley-Robinson furnace gives a gas-producer effect, the steam being split up and carbonic oxide and hydrogen formed. But the essence of the furnace is that the coal is distilled, and its gases are passed into a combustion chamber and whirled round in that chamber several times before being allowed to escape. Owing to this there is very complete mixture in a hot chamber of gas and air and ample time for complete combustion to take effect. Thus the essentials of complete combustion are secured, but this is no evidence of steam jet economy. The ingenuity of the furnace lies in the way in which the burned gases are allowed finally to depart from the partially consumed mass. And this shows how the furnace could be improved very considerably, though it's operation may already be allowed to be an excellent example of perfect combustion.

But the Cayley-Robinson furnace is after all not a boiler furnace of 500 H.P. It is in big furnaces that the convenient use of steam is so apt to prove both technically and commercially uneconomical. Further, it is not to steam, as steam, that the C.-R. furnace owes its smokelessness. It owes it to such things as are already indicated above, and to the absence of the cross-tubes referred to at p. 908. These cross-tubes are still in full vigour on the basis of "extra per water pipe," so much—it was 40s. at one time, and their surface is still called heating surface. It should be called flame-chilling surface, for no good has ever been shown to arise from them, and they are contrary to all the tenets of good combustion.

W. H. B.

The Institution of Electrical Engineers.

Having started this correspondence, I am much interested in the subsequent letters, mostly from unfortunate individuals who are in charge of large sub-stations at a "salary" of (apparently) 5s. to 20s. per week. The general cry seems to be—"The Institution is no good to us; let us have an Association." This has always been the cry, and nothing has been, or ever will be, done in this direction.

I should like to state that the Institution is the only salvation for these unfortunate and sweated engineers. Let them *all* join the Institution of Electrical Engineers, and the result, to their surprise, will be to find that owing to their number they will be able to push the Institution Council off its present too dignified perch, and make it look after the majority of not only its Members (who will be in the minority), but also its Associate Members. At present the argument is that it is to the advantage of the Members to keep down salaries. This is a very poor argument, and I advise engineers-in-charge to come into the Institution in a body and shout for themselves.

How can engineers-in-charge expect the Institution to benefit them when they will not join it?

A. J. Abraham,
Engineer and Manager.

Aberdare Electricity Works,
December 6th, 1912.

I have read with interest the recent correspondence on the subject of improving the status of station engineers, and it is to be hoped that at last a genuine effort will be made to check this ever-growing lust for cheap labour, which threatens to become an infectious disease amongst the engineers and officials of both municipal and company undertakings. Of course, we all know that the wages paid are largely dependent on the demand on the "market," and especially so when the workers are an unorganised body of men or have no Trade Union to support them. While Trade Unionism is excellent in many ways, its principles are hardly applicable to the trade, or rather profession, of station engineering, and no doubt the necessary standardisation or attainment of a certain definite status can best be accomplished by the institution of examinations on somewhat similar lines to those obtaining at present for marine engineers.

The fact that a man can pass a certain examination is, of course, no absolute criterion of his abilities, but if he can only sit for the examination after attaining a certain standard of competency in practical work, then the main object of testing his fitness is only really an additional safeguard, and is necessary for registration purposes. If it is considered necessary that the engineer-in-charge of only the boilers and machinery on a steamer should have attained to a definite standard of training and possess a "ticket," how much more important is it that the engineer in charge of the plant which, perhaps, supplies the electrical energy of an important industrial centre or town, or even a city, should have had a certain training or experience and be registered or the possessor of a certificate of competency. In the Colonies and many places abroad, engineers in charge of even comparatively unimportant plants must possess certificates, and it is surely just as necessary in our country, where we depend so largely on engineers to maintain our industrial position in the markets of the world. The examinations for charge engineers could, perhaps, be conducted either by the Board of Trade, or by representatives of the Home Office and the Institutions of Electrical and Mechanical Engineers, and both first-class and second-class certificates issued. The Association of Mining Electrical Engineers have set us a

splendid example in this direction, and I believe the Association of Engineers-in-Charge are in favour of such examinations, while last and (let us hope) not least, our Institution of Electrical Engineers are beginning to open their eyes to the fact "that there is something rotten in the state of Denmark." Although many of us won't forget the days when it was possible for a marine engineer to drop straight into the position of charge engineer in a station, and at a salary, too, of about £3 10s. a week, yet we must remember that those "balmy" days are over, and unless we make an immediate and united effort to drag ourselves out of the mud, we may very soon see the present "balmy" (?) days of 35s. a week fading away, and our last cry will be—too late!

Flashover.

I agree with both "Booster" and "Motor Generator" *re* status and salary paid to sub-station engineers. With reference to "Motor Generator's" remark that "in a few years the yard men or general labourers about the station will be expected to take charge," I would like to point out that, on a certain system, there are men in charge of sub-stations who were at one time valets, milkmen and clerks. These men, who are without technical training, now receive something like £75 to £108 per annum. How does that compare with the man who has a technical college certificate, B.Sc. London, Hon., who willingly goes on the test bed for 15s. per week?

Of course, the members of the I.E.E. are business men, and, as such, must go to the cheapest market; hence the exceptionally low salaries for brains and the somewhat of a living wage for the lucky milkman.

Some years ago I suggested the formation of an association whose object was to refuse pocket money for men's work and demand a fair salary. For, surely, the 5s., 10s. and 15s. man must have private means, and while working for such a salary, he is taking the bread from another man's mouth.

Form an Association!

W. M. E.

The Official Balance.

The writer was interested to read the further remarks on the above subject by "A.M.I.E.E.," and to learn that his experience on ship work extends over 16 years, and is more than ever at a loss to understand the laboured methods adopted to overcome a commonly experienced difficulty.

We are now assured that the 140-H.P. motor was not immersed in water, and was only suffering from general dampness. The great difficulty with which the insulation was got up to standard, would point either to the poor quality of the insulation used in the motor, or to exceptional carelessness in allowing rain and water to damage it.

If "A.M.I.E.E." is so alive to the care needed in looking after electrical machinery on shipboard, how is it he found his motor in such a bad state? If he was not responsible, why did he not blame the dockyard authorities (to whom we may assume he was sub-contractor), and insist upon them helping to get the insulation up?

It is the writer's experience that when trouble arises, due rather to bad luck than negligence, both dockyards and shipyards will always give assistance to a sub-contractor, as they have all the necessary gear for tackling awkward jobs. It seems incredible that a responsible engineer should have burnt charcoal in a confined space. No wonder the men were knocked up!

Why was a coke fire quite out of the question? Has "A.M.I.E.E." during his long experience never seen a riveter's coke fire in a confined space? Then, again, a careful engineer would have measured his head room before attempting to move the armature and decided accordingly what was the best action to adopt.

Why was it necessary to work with only a tallow dip for light, when "A.M.I.E.E." tells us that current was available for lighting purposes? Surely temporary leads might have been fixed up as in other parts of the ship.

After baking the coils, would it not have been better to allow them to cool down before returning them to the ship? The writer is under the impression that coils when hot will absorb moisture much more readily than when cold. Could not some dry sacking and sailcloth have been found to protect the coils during their hazardous journey of one-third of a mile?

We are given fewer details with regard to the drying out of the controller, but the writer's experience is that by carefully drying such parts as micanite insulators between the resistance grids, very little difficulty is experienced in getting modern well-designed controllers through the insulation test.

The writer, having had too many troubles of his own on shipwork, is not given to belittling other people's misfortunes, but he strongly objects to futile methods being disguised as insurmountable and unique difficulties, and is still of opinion that the original article affords amusing reading.

Representative.

Arbitration: Recent Decisions.

I, for one, do not in the least follow Mr. Valentine Ball's line of reasoning. Will he be good enough to cite the "recent decisions," the effect of which on the Arbitration Clause (page 938, last issue) he is endeavouring to make clear?

His question is, shortly: How to secure an agreed arbitrator? And his first (and, presumably, his most favoured) answer is: Make the engineer the arbitrator subject to an action to unseat him.

This line of reasoning seems to me the mental equivalent for the cat chasing its tail. Mr. Ball has categorically stated in the earlier portion of his article four specific cases in which the engineer will be disqualified, and we have no assurance that others will not arise, the millennium not being here yet.

Why, then, choose him, when such a wide choice is open to you admitting of no doubt whatever as to qualification, namely, the presidents for the time being of any of the Institutions?

It may be answered: But the parties may not be able to agree him when signing indentures. That may be. Some people will disagree with the solar system. How very much less likely—human nature being what it is—are they to agree the paid officer of the purchaser, be he never so good a chap—which, of course, he always is.

Omikron.

[Our correspondent apparently has not consulted the full text of the paper, of which we gave only a brief abstract. He will find that in the original Mr. Ball quoted chapter and verse in support of his statements regarding recent decisions.—EDS. E.R.]

The Earthing of the Neutral.

In your leading article under the above title in the ELECTRICAL REVIEW of December 6th, I notice a reference to my remarks in the discussion on the subject of electrostatic leakage indicators on extra-high-tension systems. I venture to think, however, that you have somewhat misunderstood my reference to these devices.

My point was not so much that the electrostatic voltmeter of 10 years ago was unsatisfactory. (A "box of tricks" was the unparliamentary expression of which I fear I was guilty, this being somewhat freely translated by you as "so unreliable as to be practically useless.") My point was rather that, at the present time, any mistrust of well-designed instruments of this nature was quite groundless, while I was forced to confess that such a statement could hardly have been made in connection with the earlier models.

If I may be allowed to transpose two of the sentences in your article, I venture to think that they put the whole matter in a nutshell. You say, "Twelve years ago we were familiar with many examples of such instruments in use on ordinary low-tension circuits and on circuits of 2,000 volts, and that was about as high as could readily be found in the United Kingdom at that time," but "of course, Mr. Peck considers pressures of all magnitudes, and it was a sign of the times to hear him speak of 2,000 and 5,000 volts as 'low voltage.'"

Now it is precisely because working pressures have so

greatly increased of late years that porcelain insulation has replaced ebonite, and cast-iron cases connected to earth have superseded the once fashionable case of "insulating" material.

This being so, I trust you will agree that my remarks, far from being, as you suggest, "an animadversion on electrostatic voltmeters" were really a eulogy, in which I am more than pleased to find that you are prepared to join.

I should not trouble you with this letter, but that I am loth to let it be thought that I could, even for a moment, have proved faithless to so early a love of mine as the electrostatic voltmeter.

Kenelm Edgcumbe.

Hendon, *December 9th*, 1912.

In commenting on the discussion on Mr. Peck's paper in last week's issue, you make the statement that the carbon powder earthing resistance which I advocated was not new, as a similar resistance had been made by the B.T.H. Co. some years ago. As this statement is somewhat misleading, I should be glad if you would allow me to make a correction.

Although it is quite true that the B.T.H. carbon rod resistances possess a negative temperature coefficient, this property is of no value when the resistance is used in connection with spark gaps for minimising the effect of surges; whereas, on the other hand, the negative temperature coefficient is of great value in an earthing resistance, a use to which the carbon rods cannot be put.

During the discussion on Mr. Clayton's paper in April, 1910, I went to some trouble to explain the difference between the carbon resistances of the compressed form and those in which carbon powder was employed, the chief point being that as soon as a crack developed in the compressed carbon the whole resistance became useless, whereas with the carbon powder no such trouble could arise.

While not pretending that the use of a resistance having a negative temperature coefficient is new, I venture to suggest that its peculiar advantages, when used as an earthing resistance in the neutral point, have never been put forward by anyone else.

H. Brazil.

Beckenham, *December 10th*, 1912.

Patents and Inventions.

Admitting that the paragraph appended to Mr. A. M. Taylor's letter of the 26th ult. may modify the statement called in question, the fact still remains that he, in his official capacity as a member of the Council of the Institution of Electrical Engineers, has advocated legislation in favour of one class of the community without stating what are the needs for and possible results of the same.

The author of the address does not give the definitions asked for, but perhaps, at this stage, it is not of importance, as, in this letter, I prefer to confine myself to asking him for proof of the need for the said legislation.

Speaking with upwards of 25 years' experience of engineering factories, including electrical, no case occurs to my mind where an employé has been deprived of the benefits due to him. At the same time, it is only fair to say I cannot recollect an employé attaining affluence by the same means.

Doubtless, before writing his address, Mr. Taylor gave this matter much more careful study than has been possible for me and can readily quote cases of hardship such as he desires to redress.

Something Wrong.

Personal Liberty.

The North-Eastern Railway men have struck work because an engine driver has been reduced for being drunk in his own time. They argue that this is an interference with personal liberty, and may lead to further such interferences. Had they struck work on a demand for a further investigation into the doubtful question as to whether the man was, or was not, drunk, I should have had nothing to say, for magistrates are often so egregiously wrong in their decisions, that I confess to many doubts on many findings. But if the man was drunk I do not think that any rational being would regard his being put back in rank as an unwarranted interference in his private life. An engine driver on a railway, and an engine man on a coalpit head, working the winding engines on which miners' lives depend, have no private lives in the sense that other men have. They have private rights up to a point, as we all have, but their actions in certain directions are, and must be, limited. A shop walker, or a joiner, may drink to excess, and with less serious consequences to the public. An engine driver who gets drunk in private life endangers, it may be, a thousand members of the public in a mass. There must be limits to the private life of every man, and such limits are drawn at the point where private action involves public danger. Is it not illegal to lay poison in a man's own garden? To drive a motor-car to the public danger?

The railway men have surely made a grievous error in striking on such an excuse as this. Common-sense forbids all consideration of such a personal liberty as private drunkenness in any person on whose sobriety and nerve the safety of the public depends. A man cannot become drunk in private and remain a safe man in public, and though no general statement can be made as to what is, and what is not, justifiable interference, all men of sense would soon come to a decision on individual cases as they arose. The strikers evidently contend that it matters nothing that drivers should be drunk so long as they are not drunk on duty. They will not gain much support for this view among the general public, but they might secure considerable support for a demand for inquiry into the magistrate's decision.

B.

NOTES FROM CANADA.

[FROM OUR SPECIAL CORRESPONDENT.]

The Ontario Power Co., at Niagara Falls, whence the Hydro-Electric Power Commission obtains its supply of current, intends to install a thirteenth unit of about 12,500 H.P. Nos. 11 and 12 are being erected now, but the demands on the station, due largely to the requirements of the Commission, are such that further extensions must be undertaken.

The Commission already referred to has recently exercised, for the first time, its power to order wires to be placed underground; this has been done in the case of the city of Hamilton, where, in the busiest sections, all wires (including telephone and telegraph wires) must go underground.

It is stated that the town of Galt is also applying for a similar ruling, so that the local companies may be compelled to do away with overhead wires in the centre of the town. It is probable that, in most instances of this kind, the municipality will lay the conduit system, and rent to the various companies such portions as are required by them.

The Dominion Government Department of Mines has for some time been experimenting with a 100-ton electric furnace for electric smelting; a report will shortly be issued on this subject tending to show that electric smelting of Canadian ores is commercially possible.

It is estimated that if a canal were built connecting Lakes Manitoba and Winnipegosis, a fall of 18 ft. would be secured near the town of Dauphin, Manitoba, from which some 40,000 H.P. could be generated. The Board of Trade of the Town of Dauphin, Manitoba, is taking the matter up with a view to a supply of power being obtained.

The Toronto Harbour Commissioners have recently presented to the City Council elaborate plans for improvement of the harbour. Aesthetic, as well as practical considerations have been taken into account, and vessels having a draught up to 24 ft. can be accommodated under the new scheme. There will be freight sheds, warehouses, factory buildings, &c., together with proper railway facilities. The factory buildings which it is proposed to erect on what is now waste ground, are estimated to yield a ground rent revenue of about £100,000 per annum.

There will be boulevard driveways on the water front, with bridle paths and walks, &c., for a distance of 11 miles.

For dredging purposes, electric lights and searchlights will be provided, so that work can be carried on at night as well as by day. Inside a breakwater, which it is proposed to build, a large space is to be filled in, 25,000,000 cb. yards of material being required for this work. The estimated cost of the whole scheme is nearly £4,000,000.

PROFIT-SHARING AND LABOUR CO-PARTNERSHIP.

By GEORGE JOHNSON.

Between Capital and Labour, two (though they should not necessarily be) antagonistic forces, there is a mighty unfilled space, which we may term the recognite and reconciliater of interests, awaiting the labours of social and industrial reformers. From a natural point of view, the attention that has been bestowed on the subject has not led to much practical application, excluding, of course, the Co-operative Society movement in the provinces; this movement relatively may be said not to exist in London.

Mere profit-sharing, which is quite different from co-partnership, has its limitations, and, so far as it has been applied, it may, generally speaking, be regarded as a temporary palliative for the ills that exist between the two opposing forces we have mentioned. In certain industries its application is comparatively easy and its advantages are obvious; but, in general, there are many difficulties to be encountered and surmounted, and not the least of them is the growth and power of Trade Union federations, whose interests, it is often asseverated, are diametrically opposed thereto.

The International Co-operative Congress in 1896 defined profit-sharing as the agreement freely entered into by which the employé receives a share, fixed in advance, of the profits. The profits are understood to be the actual net balance of gain realised by the financial operations of the undertaking in relation to which the scheme exists. It follows, therefore, that the payment of bonus on output, premiums proportionate to saving effected in production, commission on sales, and other systems under which the amount of the bonus depends upon the quality or amount of the output or volume of business, irrespective of the rate of profit earned, do not constitute profit-sharing.

It will thus be seen that co-partnership is practically an extension of profit-sharing.

Broadly, there are two modes of affording the worker an interest in the undertaking by which he is employed—viz., profit-sharing and co-partnership.

Mere profit-sharing, as at present practised, in the main consists of gratuitous or voluntary payments, with generally no legal right thereto, and an entire absence of the element of co-partnership.

Co-partnership exists only in those cases in which the worker receives, in addition to the standard wages, a share of the profit of the undertaking, that share, or a part of it, being accumulated in the business to enable him to obtain the rights and responsibilities of a shareholder or a partner, as the case may be.

The subject is one that is likely to come prominently before the public mind in the future.

To those who evince practical sympathy with the amelioration and uplifting of the lot of the worker, improved relations between employer and employed, industrial efficiency, the greater security and the extension or expansion of our industries, the recent report by the Labour Department of the Board of Trade on "Profit-sharing and Labour Co-partnership" will be found of great interest and assistance.

The Report furnishes, after the usual introduction, a general summary of profit-sharing and co-partnership in private firms and companies, a detailed account of schemes of various types, opinions of employers as to results obtained by profit-sharing and co-partnership, profit-sharing and partnership in co-operative societies, the conversion of ordinary business into co-operative societies, and other valuable matter, which it is impossible to discuss in detail in the limits of this brief article.

It would appear from the data in the chapter or section relating to the application of such schemes to private firms and companies, that 299 profit-sharing schemes have been born up to 1912, of which 166 are now defunct, leaving 133 with an employment of 106,189 workers. There seems to have been only one scheme prior to 1865. This number of 133 is obviously remarkably small for a nation of traders; but the report is hopeful, and it is gratifying to observe that out of the 299 schemes inaugurated, 104 have been started since 1900, and that 86 of the 104 were in existence in August, 1912.

The facts set forth in the report prove that the adoption on one or other of the numerous forms of the profit-sharing system is capable of affording to employés considerable advantages. These advantages include the opportunity of receiving an addition to their normal remuneration, the provision of special facilities for thrift, and in many cases, a certain measure of control over the management of the undertakings by which they are employed. At the same time, the opinions of employers quoted or summarised show that the methods of profit-sharing and co-partnership are, in numerous instances, considered by practical men, who base their judgment upon actual experience, to produce excellent results in the direction both of developing a higher degree of efficiency on the part of employés and of bringing about those harmonious relations between employers and employed.

DIGGING POLE HOLES WITH DYNAMITE.

Sometimes it is necessary to set a pole in very hard clay or frozen earth. Under these conditions, dynamite can be employed to advantage in digging the pole holes.

The illustration, fig. 1, from *Popular Electricity*, gives a very good idea of how this is accomplished. A chuck drill for sub-soiling, as shown in fig. 2, is used for making the hole. It is made of 1¼-in. wrought-iron pipe. The part A is 4 ft. long, with a full-threaded

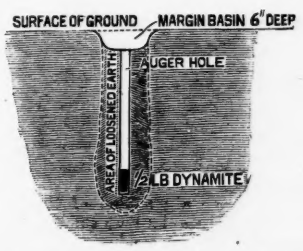

Fig. 1.—Method of Digging Pole Holes, Using Dynamite.

tee at one end. A steel, pin-shaped point, 6 in. long, is welded into the other end of the pipe. The handle is made up of two 12-in. pieces of 1¼-in. pipe screwed into the tee at H. A piece of 1¼-in. pipe, K, 4 ft. long, that is threaded at one end and provided with a coupling at the other end, is intended for use as an extension for the main part A.

The drill can be buried by one or two men. The hole is made about 6 in. less in depth than the hole which is to be obtained by blasting. The cap and fuse is attached to the dynamite, and it is dropped to the bottom of the hole without tamping; that is, no earth is to be placed on top of the dynamite, so that there will be practically no resistance between the dynamite and the surface; then light the fuse and get out of the way.

The method is simplicity itself, as the chuck drill will almost go through solid rock. Of course, in solid rock, it is necessary to use a solid bar and sledge.

Regarding the amount of dynamite necessary, the use of a ½ lb. of 60 per cent. Atlas or Hercules dynamite is ample for a 5-ft. hole. Du Pont dynamite, 60 per cent., is recommended, as it is quick acting, and follows the line of least resistance (the untamped hole) in such quick time as to have practically no shattering effect on the ground, except within the immediate radius of the drilled hole.

The number of holes that can be prepared and shot in a day depends upon the men and the character of soils. Two men are able to punch, load and shoot in the neighbourhood of 200 holes per day. As an example of the work where the blasters must firmly tamp all holes, such as when sub-soiling in agricultural work, two

men can shoot 194 holes on 15-ft. centres. Of course, the telephone pole holes are further apart, and the men must cover more distance.

A portable magazine should be used for carrying the dynamite, and the instructions which accompany the explosives as to capping, firing and handling, should be carefully read and followed.

As to the average cost per hole, 60 per cent. dynamite costs about 22 cents a lb. One cartridge, that is ½ lb., is enough for a hole. Allowing 1 cent for the cap, and about 2½ cents for the fuse, the total for material will be about 15 cents. The labour cost will be for about 100 holes per man per day.

Of course, for work of this class, the materials will almost

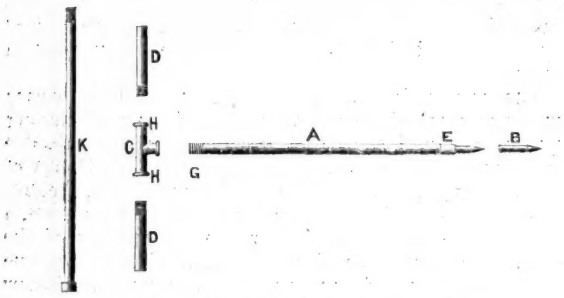

FIG. 2.—DETAILS OF THE CHUCK-DRILL.

invariably be purchased in quantities. The advantages of quantity prices can be obtained, thereby reducing the cost even below these figures.

The instructions furnished by the makers for handling the dynamite are very complete. As it is really a very simple matter to handle it safely, this method of making holes should be extensively used.—H. R. VAN DEVENTER, in *Telephony*.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

An Avery Weighbridge at Sunderland.

The Sunderland Electricity Department has recently installed a new weighbridge, the manufacture of which, and the alterations to the gantry, were entrusted to MESSRS. W. & T. AVERY, LTD., of Birmingham. The machine is entirely self-contained, the principle of construction being the three-lever type for which it is claimed all torsional stress is avoided, and the platform allowed to swing in the direction of the traffic, thus preventing undue shock and wear to the knife-edges and bearings.

The frame is fitted with joggle joints, machined and bolted together, which prevent any shifting under stress which would result in variation in weighings, and the platform, measuring 17 ft. × 6 ft., is fitted with steel rails fixed at the usual regulation gauge of 4 ft. 8½ in.

The wearing parts—in a machine of this character, of great importance—are made of special high grade steel, shaped, hardened and lapped, on the interchangeable system which ensures rapid replacement, and after the exchange the machine will continue to weigh accurately.

The pillar is of the arch pattern, and the steelyard is of the ticket printing type, which indelibly prints the weight on a ticket at the time of weighing, both gross and tare weights being printed on the same ticket, thus avoiding all disputes in accounts. There are no loose weights to be handled or mislaid, as the steelyard is graduated to its full capacity of 30 tons by divisions of 7 lb. The fixing of the weighbridge was quite exceptional, as all the coal for the station comes in from the colliery over a single track gantry running at a height varying from 10 to 25 ft.

In order to erect the weighbridge it was necessary to entirely pull down one section of the gantry and rebuild it with the weighbridge fixed with the rails on a level with those on the gantry. Owing to the necessity of non-interference with the coal supply, a short time could only be allowed, and the replacing the section of the gantry, and placing and adjusting the weighbridge in position, was completed in 27 hours.

The whole work was carried out by the local branch of Messrs. W. & T. Avery, Ltd.

Steam and Water Meters.

THE BRITISH THOMSON-HOUSTON CO., LTD., of Rugby, have developed and patented "flow meters" for steam, water and air based on the principles of the Pitot tube and the Venturi meter; the former is applicable to pipes of any diameter down to 2 in., while the latter is used only for pipes of 2 in. diameter or less. The meters for steam differ very little from those used for air or water. In the case of the Pitot tube type, a "nozzle plug" having suitable perforations, on opposite sides of an internal partition, is screwed into the pipe in which the flow is to be measured, and the respective sets of openings are connected to a mercury manometer on which the pressure difference is registered. In the other type an "orifice tube" is inserted in the main flow, having a tapered constriction at which the pressure of the fluid is reduced owing to the increased velocity, in accordance with the well-known principle; the loss of pressure—which is, of course, regained when the fluid has passed

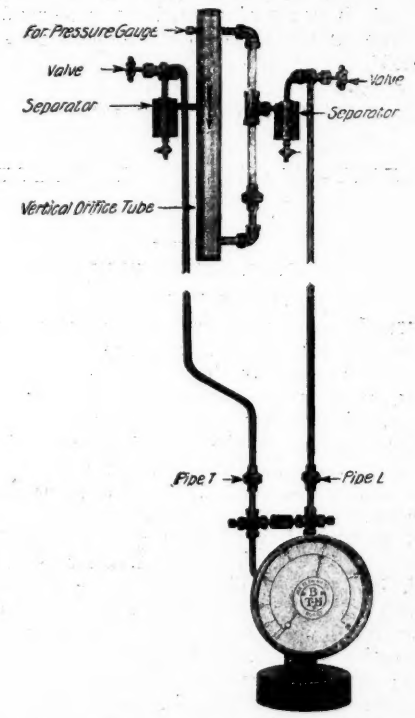

FIG. 1.—ARRANGEMENT OF B.T.H. FLOW METER.

the constriction—is measured in the same way as in the former type. We illustrate in fig. 1 an "orifice tube" meter connected with an indicator, which is shown in detail in fig. 2.

The body of the indicator consists of an iron casting cored out as shown to form a U-tube, the change of level of the mercury being communicated to the mechanism by a float and cord. As the tube must be closed, a magnet on the spindle of the pulley is used to control a magnet attached to the external pointer, a copper plug between the two magnets serving as a non-magnetic wall to the

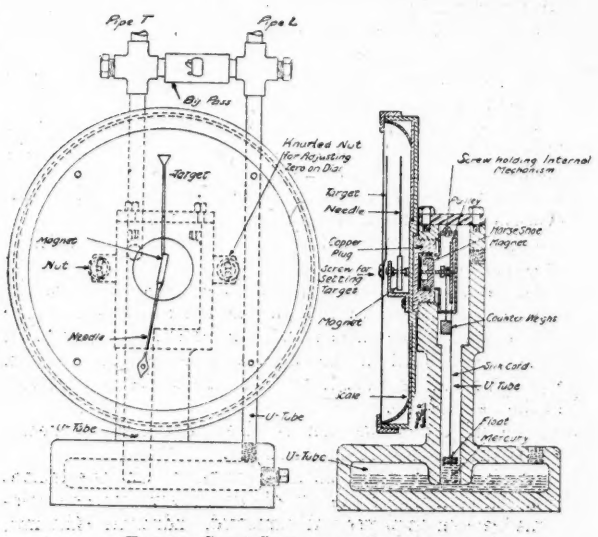

FIG. 2.—CROSS-SECTION OF INDICATOR.

tube at this point, and as a damper to prevent oscillation. A "target" adjustable from the outside is provided, to indicate the normal rate of flow desired. The scale is calibrated according to the nature of the fluid to be measured and the units used, as, for example, lb. of steam per hour (at given pressure, superheat, &c.), gallons of water per minute, cubic feet of free air per minute, &c. A fresh calibration constant is necessary if a meter is to be used under changed conditions.

The meter illustrated is of the stationary type; a portable instrument is also made, which, unlike the former, is capable of a great variety of applications without recalibration, the indications being given by a mercury manometer, which can be inclined so as to vary the sensitiveness over a very wide range. The readings are interpreted with the aid of a set of scales. Lastly, a recording instrument of more elaborate construction is made, which records the rate of flow on a moving chart; this is actuated by the unbalancing of a U-tube partially filled with mercury when there is a difference of pressures in the limbs of the tube. As the scale of the ordinates varies throughout, the ordinary planimeter cannot be used to integrate the records and determine the total amount of fluid that has passed the meter, but a special B.T.H. planimeter has been devised to overcome this difficulty. It will be seen that considerable ingenuity has been expended in devising this series of apparatus, which should prove of great utility to the station engineer in these days of minute analyses and voluminous records.

A Semi-Automatic Panel with "Inching" Features.

The Adams Manufacturing Co., Ltd., of Bedford, have recently introduced a semi-automatic panel, with "inching" features and wide speed control by shunt regulation.

These panels are made up in two separate parts or in one complete unit, as may be required, and are furnished with a main D.P. quick-break switch of robust construction.

The semi-automatic starting switch is so arranged that, by one single upward movement of the handle, the motor is started and automatically accelerated in a predetermined time, regardless of the operator, the time element being adjustable.

The working of the switchgear is made visible by means of a glass panel, which is fitted in the side, and a push button is provided by

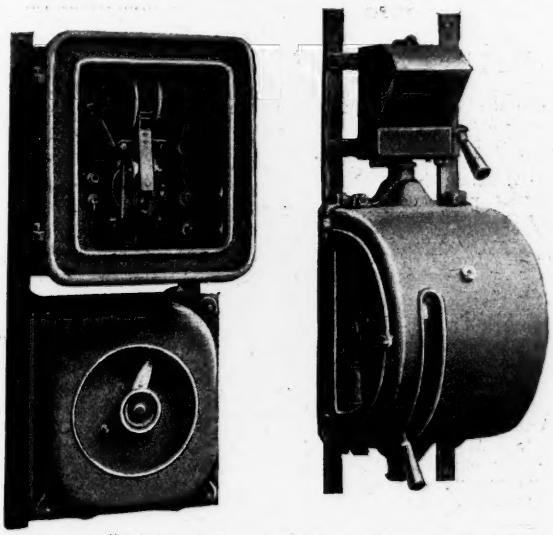

Fig. 3.—"Igranic" Semi-Automatic Starting Panel.

which the motor can be instantly stopped. When furnished with an overload trip, this is operative throughout the starting period. By means of the magnetic switch, the panel can be mounted in any suitable position.

All circuit making and breaking is removed from the starting switch and is handled under the best possible conditions and under the influence of a very powerful magnetic blow-out. Mounted together with this switch is a shunt field regulator giving a wide speed range.

The panel consists of four independent units, making the equipment particularly flexible and applicable to almost any condition of service.

Prometheus Convector.

The British Prometheus Co., Ltd., of Salop Street Works, Highgate, Birmingham, have introduced a new design of convector, which has been extensively installed on board ship; the elements are made on the company's well-known system, and are guaranteed for five years. The company is adding many new designs to its series, and has showrooms in London, which are very fully equipped with cooking and heating apparatus, and are open for the use of contractors and their customers.

The Adnil "Autocom" Telephone.

The Adnil Electric Co., Ltd., of Adnil Buildings, Artillery Lane, E.C., have brought out a new type of intercommunication telephone under the above title, which we illustrate in fig. 4. The special features of this instrument, which is fitted with a hand-combination set, are that it may be fixed either on the wall or on the table, and that a five-line set can be increased to a 20-line set without removing it from its position. These points will appeal both to the contractor and to the user, the advantage of being able to start with a small system, and extend it as may be found desirable, being especially attractive. In this type of instrument calls may be recived and answered irrespective of the position of the line selector at the station called, and cross-talk is reduced to a minimum. It is

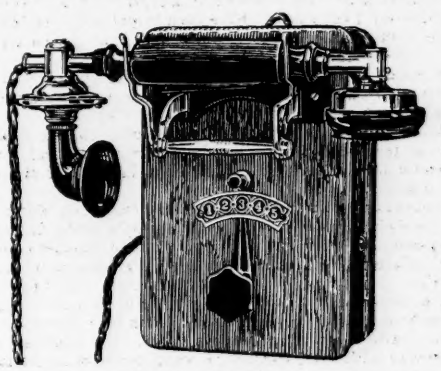

Fig. 4.—Adnil Convertible "Autocom" Telephone as Wall Set.

normally arranged for common-battery working. The conversion from wall to table set is effected by the addition of a flexible cable and connecting-box.

LEGAL.

F. W. Potter & Co. *v.* Opera Omnia, Ltd.

In the Shoreditch County Court, before his Honour Judge Cluer on Tuesday, Messrs. F. W. Potter & Co., of Phipp Street, Shoreditch, sued Opera Omnia, Ltd., the proprietors of the National Vibro Massage Co., of Chapel Court, Borough High Street, to recover £76 17s. 4d. for goods supplied, being electric vibrators and hair dryers, to be used by hairdressers. There was a counter-claim of £35 9s. principally for the expense the defendants had been put to in making the vibrators and hair dryers interchangeable. Samples of the articles were produced in court, and were very carefully examined by his Honour.

Mr. Werthemier, barrister, appeared for the plaintiffs, and Mr. Blanco White for the defence.

Mr. H. F. Joel, M.I.E.E., manager of the electrical department of the plaintiffs, said he was a great friend of Mr. Ansell of the defendant firm, and together they agreed on the various changes that were made in the original model of the vibrator and drier. All of them were supplied as arranged. It was an impossibility to make the drier interchangeable with every vibrator. He had heard of Barker's electric vibrator, but did not know they were interchangeable. They had from time to time effected alterations in the fixings of some of them to please the defendants, but not that they were really called upon to do so through any defect in them.

Mr. Leach then went into the box and said his firm were the Adnil Electrical Co.

Counsel: "Adnil," your firm go in for a Latin name.

His Honour: Does it mean useless?

Witness: No, sir.

His Honour: He says it does not. It is bad Latin, anyway.

Witness: The wife of the proprietor of the firm is named Linda, and it is her name reversed; that is all the Latin there is in it.

Witness went on to say that these dryers and vibrators could not be made interchangeable to be a good job. He had never heard that Barker's were made interchangeable. Potters made motors for them, and their work was always of the very best. If the dryer, when fixed to the vibrator, was loose, he was quite willing to agree that it would be extremely bad for the unhappy person in the barber's chair, as they might very reasonably think their head was coming off.

For the defence, Mr. Ansell went into the box and said he, right from the start, was continually harping upon the necessity of the two being interchangeable. They were practically useless unless they were. If they were not, it meant that, if a customer purchased a vibrator and afterwards wanted a dryer, he would have to return the vibrator to allow of a dryer being specially fixed to it. That would not be a commercially sound arrangement. Witness told the plaintiffs that he sold a good many more vibrators than dryers, but that he wanted them to fit each other. They could be made to do so quite easily, and it should have been done by such a firm as the plaintiffs. Barker's dryers, which were fans, and not hot air, like theirs, could be interchanged; that he had been told by hairdressers, and, naturally, they would fly to the easiest one to fix. He had never expressed himself as satisfied, and if there was "O.K." on the invoice it did not refer to the quality only, nor to the quantity. Repairs and alterations were carried out on the goods supplied, and the accounts for these were sent on to the plaintiffs as they came in, showing that they always considered the plaintiffs liable for not supplying as required. There were defects in the vibrators because there were "shorts," and when he had had one in his hand, and there had been a "short," it had knocked him down. The "shorts" were caused by the two poles or wires touching the metal case. They were not told there might be "shorts" until half of the vibrators had been delivered. He certainly would never have ordered the dryers had he known they would not have been made

interchangeable. He spoke of it almost daily, and, therefore, was not as careful as he might have been in putting it in the order.

His Honour: Your order simply says, "as per pattern with improved connection."

Witness: Yes, and that was never carried out.

His Honour: Has the pattern or the connection anything to do with the interchangeability?

Witness: Both have. Witness went on to say that the dryers supplied flew off from the vibrator, and he nearly had an accident with one. It would obviously be dangerous for a hairdresser to use them in that state.

Cross-examined: Witness said his contention was that he was not liable because of the failure to supply them interchangeable. They had tried to make them fit, but had failed to do so. The plaintiffs had offered to fit 36 dryers to vibrators, but he could not let them do that, as he had not got the vibrators now. He did not consider there should be more trouble in fitting a dryer to a vibrator than there would be in fitting any bayonet to any gun of the pattern for which it was made. He admitted he had not proceeded with the patent, that being because there was such a big supply from Germany, although not at the price he could produce at.

Other evidence was given as to the defects in the vibrators, and, finally, Judge Smyly found for the plaintiffs on their claim, less £9 1s., making £67 16s. 4d., and for the plaintiffs on the counter-claim, with costs.

Grevener *v.* Storey.

In the Shoreditch County Court before his Honour Judge Smyly, K.C., on December 4th, Julius Grevener, of 46, Southwark Street, S.E., electrical fitting manufacturer, sought to enforce payment from James Storey, of 290, Romford Road, Forest Gate, of a debt of £5 15s. 7d.

The Defendant said he did electrical work and traded in arc lamps, electrical fittings, and so on. The rent he was paying was £28 a year.

Mr. Robinson (for plaintiff): This debt is for electrical goods supplied, and he has paid nothing. He has had our goods, used them or sold them, and now calmly offers to pay us 4s. a month.

Defendant: I have every desire to pay, but I am driven to doing what I am doing by municipal competition. All I earned up to last Friday was 10s. for the week. I have a family of eight children, and only one of them helps me.

Judge Smyly: It doesn't sound flourishing.

Defendant: Then they are pressing me for the rates.

Mr. Robinson: You must expect that if you do not pay.

Judge Smyly made an order for payment at 4s. a month.

Tramway Accident Claim.

An elderly lady, named Wells, residing at Lewisham, was, in the King's Bench Division, on Wednesday, awarded £85 damages against the London County Council for injuries sustained by a fall from an electric tramcar in the Deptford Road on the evening of January 19th last. The plaintiff's case was that the car stopped at the corner of the Devonshire Road, and that as she was in the act of leaving it, the car started with a jerk, throwing her into the road, as a result of which she suffered injuries to the face and shoulder. She alleged that the place where the accident happened was marked as a compulsory stopping place up to the time of the accident, but that it had since been altered to "stop if required." The defendants denied negligence, and pleaded contributory negligence on the part of the plaintiff in endeavouring to leave the car while in motion.

National Telephone Co.

On the application of Mr. Danckwerts, K.C., with the assent of all parties, Mr. Justice Swinfen Eady fixed Monday, December 16th, for the hearing of a summons taken out to determine the rights of the shareholders in the surplus assets of the National Telephone Co., Ltd.

Counsel said the surplus to be dealt with was the surplus over liabilities and capital. They were now within measurable distance of a final award, and the matter would then be at once pressed on.

The Telephone Arbitration.

(*Continued from page* 906.)

On the resumption of the hearing on Monday, December 9th, the Attorney-General said that as the result of the protracted negotiations between Sir Alfred Cripps and himself, they had arrived at a settlement of all outstanding matters with which the Court had not dealt, and he was quite sure the Court would not be sorry to hear it when he informed them that one item involved 80 compensation claims. The first item settled was for plant constructed after the taking of the inventory. The claim was £658,599, and the sum agreed was £439,390. In giving these figures to the Court at this stage of the inquiry counsel said he had no desire to prejudice the view of the Commission in regard to other parts of the claim. The next item upon which they had come to an agreement was for the sum of £7,592 for certain plant and assets. The third item was for structural alterations and additions to the premises. The claim was for £6,539, and the sum agreed was £6,460. The fourth item included plant, property and assets of the company not subject to any special inventory. That would amount to £181,108. There was also included £1,250,000 for land and buildings, £243,247 for wayleaves transferred, £211,372 for licensed telephonic business at Portsmouth, Hull and Brighton; and £212,350 for the private wire business of the company, which the Postmaster-General had to take over on a three years' basis. The total claim in Item 4 amounted to £2,098,177, and the composite figure agreed on settlement was £1,225,000. The fifth item was for stores and tools not included in any other claim; the amount claimed was £434,747, and the agreed figure was £290,000. The sixth item referred to furniture, fixtures, &c., total claim £87,540, and the settlement was for £87,026. These items involved a total claim of £3.292,996, and the amount agreed in settlement was £2,055,468. Continuing, the Attorney-General said he was sure they could not have arrived at any compromise if it had not been for the reasonable spirit in which his learned friend had met him, due regard being paid by both sides to the interests of the respective parties. They were anxious to avoid protracted litigation, and to arrive at something which would represent a fair and reasonable figure.

Sir A. Cripps said he desired to confirm what the Attorney-General had said, and also to testify to the fair way in which the Attorney-General had met him, and the fair way in which the Solicitor-General had conducted the case. The figures in question had no bearing upon the matter before the Court, and would not affect it one way or the other.

His Lordship said that it was a great relief to the Court to feel that these items had been disposed of in a very businesslike way. It was self-evident that to dispose not only of 80 compensation claims, but also of other complicated matters, was to relieve the Court of sittings of almost indefinite duration, and thereby saved the parties from a large sum of money in costs. He was sure counsel had acted extremely wisely in the conclusion they had come to. He could not pretend to say that the amounts were necessarily accurate, because he had not gone into them, but he felt that counsel had gone into the matter with great care and with every desire to safeguard the interests of their clients. Counsel, in his opinion, had rendered great services to both the parties in the case and to the Court.

Sir A. Cripps, continuing his summing up for the National Telephone Co., dealt further with the question of plant valuation and the item for separate establishment. The Postmaster-General, he said, had raised the question of piecemeal construction, with the object of whittling down the claim of the company.

Mr. Justice Lawrence said there was some evidence that piecemeal construction was more expensive. The cost of ordering and estimating must be more in piecemeal construction. In the case of ordering and storing, the total sum under that head was £800,000, and his learned friend had attempted to whittle it away without putting before the Court any estimate. The figure for separate establishment differed from other figures in that it was based upon judgment, and not upon any list or experience.

Sir A. Cripps said that being an estimate it was more open to attack. The other side never came to close quarters with the company's figures, and he submitted that the company had substantiated this part of the claim.

Mr. Justice Lawrence asked what the learned counsel had to say with reference to the claim of the company in respect to contractors' profit.

Sir A. Cripps contended that the company were entited to 10 per cent., which they claimed. If employers saved that sum by undertaking the responsibility, trouble, wear and tear, they were entitled to recover it from the person to whom they were called upon to hand over the work. It would be unfair to penalise them.

Sir Jas. Woodhouse said he should not consider himself penalised if he could himself do certain work for £100,000 less than a contractor would charge for it.

Sir A. Cripps said everything depended on whether Sir James was able to get a profit on the work or whether he had to hand it over to another person.

(*To be continued.*)

Metropolitan Electric Tramways, Ltd.—Reduction of Capital.

A petition by the Metropolitan Electric Tramways, Ltd., for the sanction of the Court to a proposed reduction of its capital, came before Mr. Justice Neville in the Companies' Court on December 10th. The details are already familiar to our readers.

There was no opposition, and his Lordship sanctioned the reduction as proposed.

Prosecution under the Companies' Act.

On 4th inst. the Board of Trade prosecuted three directors of the Electric Safety Boiler Cleaner Co., Ltd., under Sec. 64 of the Companies' (Consolidated) Act, 1868, for not holding the annual meeting in 1912. The directors were Lord Louth, F. A. Mills, Kensington, and J. Brandon, Pall Mall.

Mr. Hamar Greenwood, M.P., who acted on behalf of the Board of Trade solicitor, said that the object of the prosecution was merely to see that the requirements of the Act were complied with. The last meeting of the company was held on September 10th, 1911. The company had not issued a prospectus nor done any business during the year, but shareholders had complained at the absence of the meeting. The promoter of the company was the secretary, Mr. Frank Hamilton, who had been summoned, but the charge had been withdrawn on account of his serious ill-health. Mr. Brandon said that he had resigned his seat and that every-

thing was left to the secretary. Lord Louth also said that he looked to the secretary to do all that was necessary.

Sir John Baddeley said that the defendants had shown that they had not knowingly been party to the default, and he dismissed the summons, but on the application of Mr. Greenwood he agreed to state a case on a point of law.

IMPORTANT LONDON RAILWAY SCHEMES.

South-Western Electrification.

The directors of the London & South-Western Railway Co., as mentioned in a previous issue, have decided to commence the electrification of their suburban lines with the circular route from Waterloo *viâ* Wimbledon, Kingston, Twickenham and Richmond, back to Waterloo, and also the connecting link with the existing electric line between East Putney and Wimbledon. This portion involves the conversion of 73 miles of single track. The other portions of the scheme will follow in due course, involving the conversion of a further 173 miles of single track, but it will obviously be some little time before these further extensions can be put in hand.

The company has decided to adopt the direct-current third-rail system, using 600 volts on the third rail. The directors were largely influenced in this by the fact that this system is in use on the London electric lines, including the District, whose trains already run to Richmond and Wimbledon over the South-Western metals, the convenience of being able, if necessary, to run through trains over the different lines being regarded as important.

The South-Western Co. propose to provide a power house, with a capacity of 25,000 kw. Sub-stations will be provided on the first stage of the work at Clapham Junction, Raynes Park, Barnes, Twickenham and Kingston, and the existing generating station at Waterloo will form another. It has been decided to have two classes only on the electric trains—viz., 1st and 3rd—but, at the same time, to adhere to the compartment system, in preference to the open coach as used on the Metropolitan and District Railways.

The immediate proposals provide for six trains per hour in each direction on the more important routes, and there will be electric trains leaving Waterloo at an average interval of three minutes throughout the day.

The electrical work generally will be in charge of the company's electrical engineer, Mr. H. Jones, while Sir Alex. Kennedy and his partners are the company's consulting engineers.

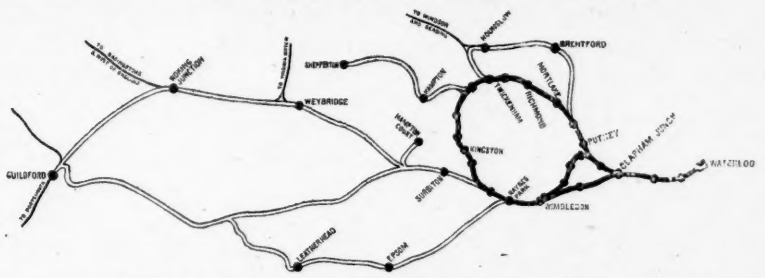

Fig. 1.—Showing the Extent of the Proposed South-Western Railway Electrification Scheme (First Section shown Black).

North-Western Electrification.

The electrification scheme which is now about to be carried out by the London and North-Western Railway Co. will mark another important step in the electrification of the suburban lines round London. Not only does the scheme provide for the electrification of 79 miles of track, hitherto operated by steam traction, but it will also enable electric trains to be worked by a main line company over one of London's "tube" railways, namely, the Baker Street and Waterloo. This is an innovation which will no doubt have considerable influence in inducing other main lines companies to undertake similar electrification work. The present scheme dates from the Act obtained by the London and North-Western Railway Co. in 1907, which authorised the construction of a new line from Euston to Watford running along side the main line, and is intended to relieve the latter of its suburban traffic. The scheme now includes not only the original proposal, from Euston to Watford, but also the electrification of the North London Railway from Broad Street to Chalk Farm, and the L. & N.W. Railway from Camden Town, *viâ* Hampstead to Willesden (H.L.), and thence over the West London and District Lines to Earl's Court, and also from Willesden over the N. & S.W. Junction and L. & S.W. lines to Kew Bridge and Richmond. The whole scheme is shown on the map reproduced in fig. 2. The extension of the Bakerloo Railway will join the L. & N.W. Railway Co.'s Euston to Watford Line at Queen's Park, where the "tube" will rise to the surface and a physical connection will be made with the L. & N.W. electric line. The scheme will, therefore, give facilities for the running of through trains from Watford to the Elephant and Castle in the South, and connection will be established with the whole system of London's underground railways, giving access to all parts of the metropolis.

The civil engineering work of the new line to Watford is being carried out by Mr. E. C. Trench, the company's engineer, and this section is making great progress; the first portion, between Willesden and Harrow, has already been opened for traffic in June last, and is now being operated by steam trains. This section will be opened to Watford in the beginning of February.

The equipment of this line for electrical working is now about to be undertaken, but the first section over which electric trains will operate will be from Willesden, over the West London Line to Earl's Court, and it is expected that these trains will be running very shortly. The system of electrification to be adopted for this important undertaking has received very careful consideration by the company under the advice of their chief electrical engineer, Mr. F. A. Cortez-Leigh, and it has been decided to adopt a direct-current system at 600 volts for the operation of the trains, using third and fourth rails in accordance with the system already adopted by the Metropolitan District and other London railways over which the company's trains will run, which system leaves the running rails free for the installation of electric track circuiting and automatic signalling.

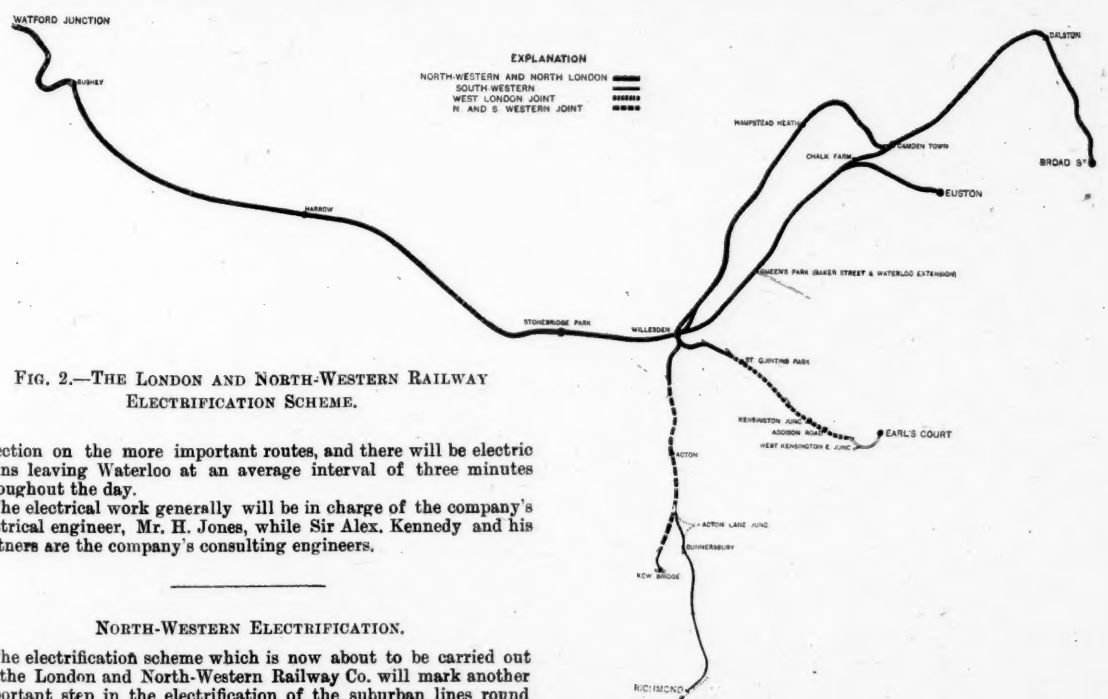

Fig. 2.—The London and North-Western Railway Electrification Scheme.

The London and North-Western Railway Co. are already inviting tenders for some sections of the electrical equipment to the specifications of the chief electrical engineer, who has entire charge of this work, and is engaged in preparing all the necessary plans, and it is hoped that all the most important contracts for this work will be placed early in the new year. The general manager, Mr. Rees, is, of course, taking a very keen interest in this work, which is being carried out under his personal supervision.

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The power station will be erected between Stonebridge Park and Wembley stations, on a site covering an area of 17 acres, adjacent to the electric line. The power station buildings are being so laid out that if necessary the power house can be considerably extended, and special consideration has been given to the important question of storing a large quantity of coal, space being available for many months' supply. Further, a good supply of water is obtainable on the site.

The very up-to-date and excellent coal handling arrangement which will be provided, enables no less than three months' supply to be handled, automatically utilising the old coal first, and after considering many proposals, Mr. Cortez-Leigh, in consultation with Sir Alexander Kennedy, decided to recommend this system. The necessary railway siding accommodation, which will be provided in the arrangements for dealing with the coal, is such that two trains can be discharged in a few minutes, and the system also lends itself readily to the convenient removal of the ashes from the power house to the trucks in the sidings. In addition to the reserve of coal outside the power house, storage bunkers will be provided, as usual, above the boilers, and will be filled by mechanical elevators and conveyors.

The power house will be a very substantial structure, and the initial plant will have a capacity of about 25,000 KW., which will consist of turbo-generators having a large overload capacity, and will be complete with the usual complement of boilers, mechanical stokers, condensing plant, &c. The whole of the generating plant will be of the most up-to-date and economical design; duplication and other provision for emergencies has been allowed for, as far as possible, to ensure continuity of supply. Similar provision will also be made in the main conductors to the sub-stations, and from the sub-stations to the conductor rails on the track.

The electrical energy will be generated as three-phase alternating-current at 11,000 volts pressure and 25 cycles per second, and will be transmitted by cables, carried on each side of the line, to sub-stations located from 3 to 4 miles apart. The cables will be entirely in duplicate, and so placed as to be well out of the way of interference from traffic operations, and where possible they will be carried above ground. At the sub-stations the current will be converted from the high-tension three-phase supply to direct current at 600 volts by means of static transformers and rotary converters, in the usual manner, and transmitted direct to the conductor rails. In addition to the transforming plant, the sub-stations will be equipped with large storage batteries and automatic boosters, which alone will be capable, if found necessary, of running a full service of trains for a considerable time. The batteries will also be of service in relieving the power house of heavy peak loads incidental to the operation of the electric trains.

The site obtained for the erection of the power station buildings will also provide ample accommodation for the shed for repairing and overhauling the electrical equipment, and as the position is approximately in the centre of the system it will tend to reduce dead mileage and also facilitate the handling of the trains generally. Further, this will enable the administrative work to be centralised, and thus obviate duplication of supervision.

The rolling stock will be of the most modern type, and will consist of motor-cars, trailers and driving trailers, and every consideration has been given to the seating accommodation, lighting, heating, &c., to ensure the maximum of comfort for passengers. The trains will be operated on the multiple unit system, so that they may be driven from either end and can be divided up in units of such number of coaches as may be required to suit the conditions of the traffic. The number of motor-cars required for the proposed service will be about 100, and during the busy hours it is proposed to run a service with five-minute intervals between trains on the Watford section of the line. The electrical equipment will be of the four-motor type, with motors of large capacity, and it is intended to operate at a high schedule speed and with an acceleration second to none in the country. The stock for working over the Bakerloo "tube" will be of special design, as it is necessary to bring it within the limits imposed by the diameter of the "tube," and also to allow for the difference in the heights of the platform levels.

The company in embarking on this undertaking have left no stone unturned to give to the public the most up-to-date system which engineering science can produce in every respect suitable to the local conditions, details having been most carefully considered with this object in view.

BUSINESS NOTES.

Trade Announcements.—THE WEST INDIA AND PANAMA TELEGRAPH CO., LTD., has removed to Spencer House, South Place, Finsbury, E.C.

MESSRS. FREDK. HODGSON & CO., of 24, Queen Victoria Street, E.C., have, owing to increased business, added to their telephone lines, which are now as follows:—City, 4674 (two lines); Hampstead, 5721 and 5565.

CONSOLIDATED DIESEL ENGINE MANUFACTURERS, LTD., AND DIESEL ENGINE CO., LTD., announce that their telephone number is now "2245 City" (three lines).

MR. ALAN WILLIAMS, late with Messrs. Crompton & Co., Ltd., has started business at 9, Queen Victoria Street, London, E.C., where he will deal principally in switchgear and switchboards made by Messrs. Eckstein, Heap & Co., Manchester, and in high-speed gas engines made by the Anderston Foundry Co., of Glasgow.

Catalogues and Lists.—From MR. C. S. NORTHCOTE we have received a leaflet of his "Utopian" lavatory basin (Therol system) to give hot and cold water supply without pipes. It is a portable lavatory equipment provided with a cupboard containing a storage tank for water with space below for soap, towels, brushes, &c. Beneath the basin is the electric heater, which runs on the ordinary lighting circuit, and a waste water receptacle.

MR. H. R. WITTING, 41, Berners Street, London, W.—Eight-page list describing, and pointing out the advantages of, the Möller single pocket air filter.

MESSRS. J. C. FULLER & SON, LTD., Wick Lane, Old Ford Road, Bow, E.—Eight-page list containing illustrated particulars and tabulated sizes, dimensions and prices of their patent block accumulators for telegraph service, train lighting, house lighting, motor-car and motor-boat service.

THE ELECTRICAL AND ENGINEERING SUPPLIES CO., Harold Wood, Essex.—Leaflet showing, and giving prices of, decorative outfits for lighting Christmas trees, also for shop window and interior illumination and display. Copies will be sent on application.

MESSRS. EVERSHED & VIGNOLES, LTD., Acton Lane Works, Chiswick, London, W.—Sixteen-page pamphlet containing an abridged description of their Dionic water tester, also its uses, method of testing, prices, and so on.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby.—List No. 389 (20 pages), containing a full and well-illustrated account of their new steam, water, and air flow meters, which are shown in our "New Devices" section to-day.

THE GENERAL ELECTRIC CO., LTD., 67, Queen Victoria Street, London, E.C.—Supplementary section ("O" 1644) of 12 pages containing illustrated particulars and prices of "Geeko" lamps and electrical novelties, including pocket lamps, torches, electric candles, hand lamps, model turbines and generators, electric clocks, massage vibrators, and so on.

BRITISH L.M. ERICSSON MANUFACTURING CO., LTD., 4, Chancery Lane, London, W.C.—Two illustrated leaflets giving brief information and prices relating to two types of their battery ringing wall telephones.

THE CONCORDIA ELECTRIC WIRE CO., LTD., Crown Parade, Cricklewood Lane, London, N.W.—20-page catalogue (No. 103) giving a large amount of tabulated, technical and commercial data regarding their "Concordin" high resistance wire for electric heating and cooking apparatus. Prices of these wires and ribbons are also given in tabular form.

MESSRS. SIMPLEX CONDUITS, LTD., London and Birmingham.—Twelve-page illustrated and priced catalogue (revised), particularising their various electrical measuring instruments, moving iron and moving coil, in both switchboard and portable types, also galvanoscopes, Wheatstone bridges, and pocket measuring instruments.

THE ECONOMIC ELECTRIC CO., Twickenham, London, S.W.—Very full catalogue of over a hundred pages giving illustrated particulars and prices of a host of small electrical apparatus and machines for young students, amateurs and others, including many lines suited for presentation purposes at this period of the year.

MESSRS. BAXENDALE & CO., LTD., Miller Street, Manchester.—Catalogue of all sorts of presents for Christmas, including electric table standards, flash lamps, and disk electric fires.

MESSRS. SCHOLEY & CO., LTD., 151, Queen Victoria Street, E.C.—Pamphlet on the "Vulcan" soldering and branding irons, showing a great variety of patterns. We understand that these appliances are in considerable demand, owing to their freedom from the troubles which have been met with in the past, and which have created a certain amount of prejudice in some quarters against electric soldering.

MESSRS. WARD & GOLDSTONE, Springfield Lane, Salford, Manchester.—This firm is as usual laying itself out for the supply of fruit, flower, and figure lamps, for Christmas tree and bazaar lighting. A list giving prices and illustrations of their series strip, miniature batten holders, and fancy lamps, has been issued, and copies can be obtained on application.

For Sale.—MESSRS. WHEATLEY KIRK, PRICE & CO., will, on January 14th and following days, sell by auction, at Gateshead, the freehold land and buildings, plant and machinery, goodwill, stock, stores, &c., of Messrs. Ernest Scott & Mountain, Ltd.

MESSRS. P. HUDDLESTON & CO., will, on December 17th, sell by auction, at Dalling Road, Hammersmith, a large quantity of electrical apparatus. See our advertisement pages to-day.

Cape Copper.—At the meeting of the Cape Copper Co. on 4th inst, says the *Times*, Mr. J. E. Champney stated that the profit for the year amounted to £80,494, as compared with £60,862 in the previous year. He hoped that the present prices of copper would be maintained for some time.

Bankruptcy Proceedings.—WESLEY SUTTON, 62, Dale Street, Liverpool, lately trading in partnership with Samuel Lord and John William Garsden, under the style of the Howe Electrical Engineering Co.—The first meeting of creditors in this matter was fixed for last week at Liverpool, but no creditors attended.

Crane Contracts.—MESSRS. ROYCE, LTD., of Trafford Park, Manchester, have received the following orders:—To construct and erect 25 electric gantry cranes for the Hull Joint Dock Committee; four similar cranes for the Alexandra Dock, Hull; 16 electrically actuated jib cranes for South Australia; two cantilever loading stages with two 15-ton cranes for South America. In addition they have orders for a number of capstans of both their ordinary and "Royce" patent free Bollard types.

Book Notices.—*Hazell's Annual*, 1913. London: Hazell, Watson & Viney, Ltd. 3s. 6d. net.—This useful work has now reached its twenty-eighth year of issue. It is edited by Mr. Hammond Hall, and its record of men and movements is revised down to as late as November 25th. As usual, there is a brief review of electrical affairs since the appearance of the last edition, and other articles deal with the cables of the world, British trade and British investments abroad, art and literature, politics and sport, national and other insurance; indeed, almost every topic under the sun receives attention somewhere. The book is one that we find it well to have always at hand.

Tait's Electrical Directory of Australia and New Zealand. Melbourne and Sydney: The *Mining and Engineering Review* Office. 5s., post free outside Australia.—This a booklet of some 80 pages, containing the following sections:—(1) Alphabetical list of undertakings, with particulars of plant, output, &c.; (2) list of undertakings classified according to location in Australian States or New Zealand; (3) engineers in charge of plants and their addresses. In view of the growth of Australasian electrical undertakings, and the interest that English firms naturally take therein, this directory should be of considerable service.

The Central (the Journal of the Old Students of the City and Guilds (Engineering) College). Vol. IX, No. 29. December, 1912.—An interesting account is given of the Grand Central Terminal, New York, by W. A. Del Mar; the "Awakening of China" is described by W. C. C. Langdon, and the Compayne transmission gear, power plants in Canada, and the Bruce electrically-controlled steam whistle, are other subjects dealt with.

Poulsen Patent.—According to a notice in the *London Gazette*, Mr. Justice Warrington has directed that the petition of the Telegraphone Corporation, of New York, as assignees of patent No. 8,961 of 1899 (granted to Valdemar Poulsen, of Copenhagen, for a "Method of and apparatus for effecting the storing up of speech or signals by magnetically influencing magnetisable bodies") for an extension of term, is not to be heard before March 1st, 1913.

Christmas Holidays.—MESSRS. MAWDSLEY'S, LTD., of Dursley, Glos., announce that their works will be closed from mid-day on Saturday, 21st inst., to the morning of Monday, the 30th.

THE WALSALL ELECTRICAL CO., LTD., of Walsall, are closing down from Tuesday, December 24th, to 30th, for the holidays.

South Africa.—Our contemporary, the *British and South African Export Gazette*, states that so rapid is the growth of the demand for electric current at Lourenço Marques that the Delagoa Bay Development Corporation, Ltd., have been compelled to order further generating plant. There is also a corresponding development of the market for fittings and small motors.

The same journal also states:—"The proposal for electric light and telephones at Elizabethville, Katanga, still hangs fire pending local support. A trackless tram scheme has at last been adopted by the Boksburg Municipality, and contracts have been awarded. It is proposed to establish a water and electric light supply at Ermelo, Transvaal Province, at a total cost of about £22,500. An electric lighting scheme is being considered at Estcourt, Natal Province. A hydro-electric power scheme is being considered by the Harrismith (O.F.S. Province) Municipality, which will involve the purchase of a considerable quantity of machinery and plant.

"The Rand Water Board are in the market for an electrically-driven high-lift centrifugal pump for their End Street depôt."

Dissolutions and Liquidations.—FOREIGN RADIAL AXLE CARS, LTD.—A petition for winding up this company has been presented by Messrs. Milnes, Voss & Co., Ltd., of Birkenhead, creditors, and it is to be heard on January 14th in London.

RAWORTH'S TRACTION PATENTS, LTD.—A meeting is to be held at 126, Bishopsgate Street, E.C., on January 14th to hear an account of the winding up from the liquidator, Mr. F. J. Riches.

SIMMS MAGNETO CO., LTD.—This company, of Kimberley Road, Kilburn, N.W., is now winding up voluntarily. A meeting of creditors is called for December 17th at the Institute of Chartered Accountants, Great Swan Alley, E.C.

COWPER-COLES INVENTIONS DEVELOPMENT CO., LTD.—A meeting of creditors was called for 11th inst. at Westminster.

NORTH-WESTERN ELECTRICITY & POWER GAS SYNDICATE, LTD.—A meeting will be held at Hanley on January 7th to hear an account of the winding up from the liquidator, Mr. C. E. Bullock.

LIGHTING and POWER NOTES.

Algeria.—A concession has been granted to Mons. A. Grammont, of Pont de Cheray (Isère), to lay down four lines of electric tramways in the city of Constantine, Algeria.—*La Lumière Electrique.*

Batley.—The electrical engineer has been instructed to prepare and submit plans and estimates, with a view to an early application to the L.G.B. for sanction to the raising of a loan for an extension of the present generating and distributing plant, providing as alternatives (*a*) a steam, and (*b*) a gas generating plant.

Bedford.—The T.C. has decided to install a 400-KW. Diesel engine and alternator, to be constructed by Messrs. W. H. Allen, in the power station; the cost, £8,980, is covered by the loan application to the L.G.B. mentioned in our last issue.

Brazil.—A syndicate has been formed at Blumenau, in the province of Santa Caterina, to establish a large power station at falls on the River Itajahy in order to supply electricity for lighting and power purposes to the city and suburbs.

Brighton—Hove.—With reference to the electricity question at Hove, the Brighton T.C. has passed a resolution requesting the Lighting Committee to take into consideration the question of negotiating with the Hove T.C. as to the supply of electricity in bulk to Hove.

Burton-on-Trent.—Application is to be made to the L.G.B. for sanction to borrow £8,500 to provide for expenditure on mains, services and transformers during the next three years; 50 electric irons are to be purchased for distribution amongst consumers, and after one month's trial, such consumers are to be asked to purchase them through local contractors.

Canada.—The Calgary Power Co. is about to spend $1,000,000 (£200,000) on two additional units at its hydro-electric station, making the plant equivalent to 20,000 H.P. in all. Prices for power will be reduced. The city electrical department has put in 3,200 new lighting connections during 1912.

Subject to the approval of the necessary loan by the burgesses, estimates for the following additional electrical equipment have been authorised at Regina: 1,500-KW. set already ordered for delivery in August, 1913, £8,000; poles and wires, £15,000; street lighting extensions, £4,000; meters, £4,000. The demand for electricity has increased from 833,039 units in 1907, to 4,179,948 units in 1912. The estimated demand in 1913 is put at 7,000,000 units. The pumps for the city water supply are at present operated in connection with the power station, but in the new power house about to be put in hand the two services will be separated.

Chesham.—With reference to the street lighting question, the Bucks. C.C. has passed a resolution dispensing with the penalty imposed by the Local Government Act in the case of five members of the U.D.C. who are shareholders in the Gas Co., "So as to enable them to freely vote on the question at which tenders for the supply of gas or electricity for public lighting or power are considered and dealt with by the U.D.C."

Clacton-on-Sea.—The U.D.C. on December 4th decided to apply to the L.G.B. for a loan of £5,100 for the provision of a Diesel oil engine and generating set of 250-KW. capacity.

Continental Notes.—AUSTRIA.—According to a return lately issued by the Electrotechnische Verein, of Vienna, there are now close on 1,000 electric lighting undertakings in Austria, supplying current to nearly 2,000 towns and villages.

DENMARK.—A municipal central electric lighting station is about to be established in the town of Struer, Jutland, the contract for the work having been secured by the Siemens-Schuckertwerke.

The Sydostsjalland Electricitäts Aktieselskab is the name of a company which is reported to be in course of formation at Kjöge, to establish a large generating station for the supply of electricity for lighting and power purposes in the southern portion of the Island of Zeeland.

SPAIN.—La Sociedad Energia Electrica de Cataluna, of Barcelona, is increasing its capital to £80,000, for the purpose of extending its operations in the province of Catalonia.

NORWAY.—The Ryfylke Electrical Works, which owns several waterfalls in the neighbourhood of Stavanger, has just completed the first power station at one of the falls. In the first instance only about 2,000 H.P. has been utilised, of which 1,500 H.P. has been contracted for by the Stavanger Electrical Steel Works, where the machines are now being installed. The plant of the Ryfylke Electrical Works was subjected to a trial run recently with very satisfactory results. The generators are two in number, of 1,000 H.P. each; one of them has been delivered by the Brown-Boveri Co. and the other by Messrs. Siemens-Schuckert.

The Norwegian Company Meraker Brug has recently applied to the Government for a concession for transmitting 15,000 H.P. from the waterfalls at Meraker to the seaside at the Trondhjemsfiord, where the company owns excellent sites suitable for industrial purposes, at Hommelviken as well as at Murviken. The energy to be transmitted is to be derived from the Gjössefos, which is now being harnessed. The utilisation of this fall is not an easy task, as the water will have to be conducted through a tunnel about 900 m. long, which will require considerable expenditure of capital.

The same company only a few months ago lost by fire one of its pulp mills at Meraker. Instead of rebuilding this mill, it has now been decided to utilise the surplus energy for the electrical smelting of ore, and the necessary steps have already been taken for the erection of smelting works on the site of the pulp mill.

The utilisation of the Trollhättan Waterfall for the generation of electrical energy has been of direct benefit to the City of Gothenburg, which is now illuminated by electricity at an extremely low cost. Last winter efforts were made, not only to utilise the current for industrial purposes, but to extend its adoption for the heating of public and private buildings. These efforts have proved a great success. In consequence, a dearth of heating apparatus has manifested itself, and manufacturers might find profit in directly catering for this opening.—*Elektrotechnik und Maschinenbau.*

Conway.—The town clerk submitted, at the meeting of the T.C. on December 4th, correspondence between himself and the B. of T. respecting an application by the Council for a further extension of time to carry out the obligations under the Electric Lighting Order. It was decided to inform the B. of T. that the question of electric lighting was receiving the Council's attention. The engineer was requested to submit at the next meeting a report as to a scheme for the electric lighting of the Conway Bridge Embankment.

Crewe.—The T.C. decided on Wednesday last to replace 30 to 40 oil lamps in the Coppenhall district with electric lights.

Doncaster.—The manager of the electricity works has been authorised to complete arrangements for the holding of an electrical exhibition in the Guild Hall. Admission will be by ticket, which may be obtained from the electricity works or from any of the electrical contractors in the town.

The T.C. decided on the 4th inst. to borrow £5,000 in respect of the proposed extension of electric cables to Balby and Hexthorpe and £3,000 in respect of the extension at Bentley, for which a provisional order is now being sought.

East Ham.—The engineer has been directed to prepare a report upon the question of giving a supply of electricity in bulk to Barking, and also as to whether a portion of that Council's tramways over which it is proposed to make through running arrangements from Aldgate should be leased.

Epsom.—The U.D.C. on the 3rd inst. decided, after hearing reports from the electrical engineer and waterworks consulting engineer, to accept the offer of the Electricity Supply Committee to undertake the whole of the pumping at the waterworks at a cost of 3¾d. per 1,000 gallons. The pumping is at present being done by suction gas. The cost of installing the necessary plant and laying the main will be £850.

Hastings.—The owners of machinery in Hastings and St. Leonards are up in arms at a decision of the Assessment Committee to assess machinery specially. In this matter, we understand, the Overseers and Assessment Committee are at variance, the former contending that it is unwise in a place where there is comparatively little machinery, thus to tax local industry.

Hazel Grove (near Stockport).—At a meeting of the U.D.C., it was reported that representatives of the Council had had an interview with Parliamentary agents in London respecting application to the B. of T. for an order to supply electricity within the district, and that the Electricity Sub-Committee had received and considered an up-to-date report from Mr. Crews (consulting engineer) upon a scheme of electricity supply together with an estimate of the cost. It was decided that application be made to the B. of T. for a prov. order for the purpose named, and that the seal of the Council be affixed to the memorial praying for such order.

Holmforth (Yorks.).—At the last meeting of the Council, it was stated that the application of the Council for a prov. order had received the assent of the Select Committee of the House of Commons. The Electricity Committee of the Council is now in communication with the Yorkshire Electric Power Co., in respect to arranging terms for the supply of electric power required by the Council.

Lisbellaw (Co. Fermanagh).—With the electric lighting of the houses in Lisbellaw, the village now has quite an up-to-date appearance. A movement is being set on foot to light the streets also with electricity. The sanction of the Rural Council to carry overhead wires and strike a rate for the village to cover the cost of the lighting will be sought.

Liverpool.—The men employed in the electrical department of the shore gangs of several of the leading steamship companies of Liverpool, came out on strike last week for an increase of wages to 39s. 9d. per week and shorter hours. At present the wages range from 36s. to 37s. 6d. per week.

Llanfair Caereinion.—An E.L. scheme for the parish has been prepared by Mr. B. Thomas, of Manchester, and as the canvass for consumers has exceeded all expectations, it will be carried out. The capital expenditure is placed at £1,000. Mr. David Davies, M.P., has offered to take £500 in shares in the company to be formed.

Leeds.—At the City Council on the 4th inst., Alderman Smithson moved that the section of the Parliamentary Bill, which empowers the Corporation to acquire lands in the city and to erect an electrical generating station and other works, be deleted. Thirty voted for, and 30 against the motion, and the town clerk said that the resolution to exclude the section having been defeated, the clauses remained in the Bill, but it was necessary that the Bill be approved by at least 35 votes of members of the Council, and as that number had not been forthcoming, that portion of the Bill automatically fell to the ground.

London.—Woolwich.—To enable consumers, who are supplied under contract and purchase more current than they are able to consume under the normal working of their business, to use the excess current by additional connections, it has been decided to allow these consumers whose premises are wholly lighted by electricity, to install additional arc or other lamps without increasing the normal maximum demand charge, provided that they agree to pay an additional sum over and above such charge at the rate of £5 per KW. installed, all current used being charged at 1d. per unit, with discount allowances as under principal contracts. To those consumers who are supplied at the flat rate charge, and who desire to make temporary additions to their installations for decorative or display purposes, a charge of £1 10s. per KW. is to be made. An agreement has been sealed with the West Ham Corporation consenting to its giving a supply of energy to Pearson & Son, Ltd., for use under their contract for the construction of the South Albert Dock, upon payment by the West Ham Corporation of £30 per annum during the whole of the period of supply.

Fulham.—The electrical engineer has been directed to prepare a scheme for lighting High Street, Hill Road, Broadway, and Merton Road, with 300-C.P. metallic-filament lamps in lieu of the present 50-C.P. size and existing arc lamps.

Poplar.—The Electricity Committee states that it has received a report from the electrical engineer upon the policy and progress of the undertaking. This report shows that the revised system of charging, on the basis of a fixed charge per annum, and ½d. per unit on consumption, has resulted in a large increase of business. Until the present year the normal annual increase has averaged 1 million units since 1906, with an increase in demand of from 300 to 400 KW. per annum. The increase in output this year will be from 2½ to 3 million units, with an increased demand of 1,000 KW. The total rated capacity of the plant, before the present extensions were entered upon, was 4,200 KW.; the plant nearly ready for use, and in course of completion, in the new building, is rated at 6,000 KW., making a total of 10,200 KW. The showroom in East India Dock Road has proved self-supporting, and has been of considerable benefit to the undertaking in the rapid extension of business.

Mickleover.—The Repton R.D.C. has consented to Derby T.C. obtaining a prov. order for electric light at Mickleover.

Newport (Mon.).—The T.C., on the 10th inst., confirmed the recommendation of the Electricity and Tramways Committee to enter into supplemental agreements with the General Electric Co. in regard to their existing contracts. The Committee also placed on record its "appreciation of the able services rendered by Mr. Nichols Moore, the borough electrical engineer, in carrying through the negotiations with the General Electric Co."

North Bierley.—The Guardians are seeking information as to the cost of installing electric light at their workhouse at Clayton, in place of gas.

Pontefract.—At the meeting of the T.C. on Thursday last week it was reported that the transfer of the Council's powers, under its Electric Lighting Order, to the Yorkshire (West Riding) Electric Tramways Co., had been completed.

Portsmouth.—With reference to the tenders received for installing the electric light at the infirmary extensions, the B. of G. has decided to have the specifications amended, as required by Mr. Foale and the architect, Mr. Smith.

Reading.—The T.C. has invited the Electric Supply Co., Ltd., to tender for lighting the streets in the borough.

Rochdale.—With reference to our brief note of last week, stating that the Gas and Electricity Committee had decided that application be made to the L.G.B. for sanction to borrow £30,000 for extensions to electricity works and plant, the following are the detailed particulars:—Engine room and boiler house extensions, water settling tank, and strainer gear, £5,500; two three-phase steam turbo-alternators, with cable connections. Two condensers, with pumps, pipework, valves, and meters; suction, delivery, exhaust, and drain pipes; one 500-KW. three-phase motor alternator, with cable connections. Additional switchboard panels, £13,160; two water-tube boilers, and superheaters, and economisers. Two boiler feed pumps, with suction and feed pipes, hot well, cold water tank, and valves. Steam blow-down and drain pipes with valves. Coal and ash elevators, and storage bunkers, £9,260; induced draught plant for old chimney, £500; transformers, wiring, and contingencies, £1,580; total, £30,000.

The suggestion to light the Town Centre by electricity has been deferred owing to the pressing demand for current elsewhere.

St. Annes-on-Sea.—The U.D.C. has resolved that application be made to the L.G.B. for sanction to borrow £6,000 for mains, services, and meters.

St. Helens.—The T.C. has applied to the B. of T. for a loan of £6,800 for electricity purposes—viz., transformers, £1,000; sub-station building, £500; sub-station equipment, £600; overhead mains, £1,000; underground mains, £3,000; services, £700.

Sheffield.—For the years ending March 25th, 1913, and 1914, the Electric Light Committee estimates that it will have a surplus of £3,314 and £10,695 respectively. The total income is estimated at £107,688 and £121,130, as against an expenditure of £40,882 and £44,639. Regarding the tramway undertaking, it is estimated that the total receipts for the two years will amount to £355,233 and £363,019, while the estimated net balance is expected to amount to £27,740 and £26,058 respectively.

Southampton.—The T.C. has decided to hire out electric radiators at a rental of 2s. 6d. per quarter, with 25 per cent. per annum additional rent for radiators above the value of 50s.; 100 radiators are to be purchased forthwith.

Stoke-on-Trent.—The T.C. has applied to the L.G.B. for a loan of £12,000 for prospective and current work in connection with the electricity undertakings in the borough.

Stretford.—Application is to be made to the L.G.B. for sanction to borrow £5,500 for distributors and services and £2,000 for motors. At a recent meeting of the E.L. Committee, the chairman reported at some length upon the financial results of the working of the undertaking for the past year, and stated, with respect to the forthcoming year, that the increased cost of coal would add materially to the cost of production, but in all probability this would be largely compensated by the increased price obtainable from the Corporation for current supplied for traction purposes. The Committee has decided to reappoint Mr. Miller consulting engineer for the year ending October 31st next.

Swanscombe.—The Gravesend T.C. has applied to the Dartford R.D.C. for consent to mains being laid at Swanscombe for the supply of current to the Empire Cement Co. and other intending consumers. At a meeting of the R.D.C. on December 3rd, there was slight objection to the application, and the matter was deferred for fuller particulars to be obtained. Some 10 years ago the Council consented to a prov. order for electric light being obtained by a private company, but the scheme never matured.

Swindon.—The T.C. on December 3rd decided to rescind the acceptance of the tender of the Diesel Engine Co. for a Diesel generating set. A special meeting is to be called to further consider the matter.

Tonbridge.—A L.G.B. inquiry was held last week into the application of the U.D.C. for a loan of £2,560 for additional generating plant, and £1,000 for mains extensions. There was no opposition. The Council proposes to install a 100-KW. set.

Torquay.—To all consumers who use over 1,000 but not more than 2,000 units of electricity in any quarter for heating, cooking, and other domestic purposes except lighting, a reduced charge of '9d. is to be made, while those who exceed 2,000 units are to pay at the rate of '8d. per unit.

Walsall.—The T.C. is being asked by the Electricity Committee to sanction the laying of a cable at an estimated cost of £1,400, from the generating station, for the purpose of supplying the Caldmore district with alternating current, and also providing the means for augmenting in the immediate future the supply to the Highgate district.

West Africa.—A survey is now being made on parts of two rivers in the Congo, having an aggregate length of 450 miles, with the idea of exploiting their water-powers in the generation of electricity, also to improve the navigation. It is expected that the work will take about one and a-half years to complete.—*African Engineering.*

West Ham.—The Electric Light Committee has received a letter from the Barking U.D.C., stating that the Council has had under consideration the question of extending the generating plant, but before coming to a decision thereon it desired to know whether the West Ham authority would be prepared to give a supply of electricity in bulk, or, alternatively, whether West Ham would be prepared to consider the question of the transfer to it of the Barking Council's Electric Lighting Order, and the works executed thereunder, upon terms. Having fully considered these terms for a bulk supply, the Committee has decided not to entertain the application.

Wimbledon.—Application is to be made to the L.G.B. for sanction to borrow £5,650 made up as follows:—Mains and house services, £3,000; transformer sub-stations, £800; meters, £1,850. It has been decided to fix, at a cost not to exceed £105, two air filters on the two 1,000-KW. alternators at the electricity works, in order to minimise the risk of breakdowns, owing to the accumulation of dry dust.

Woodbridge.—The U.D.C. has approved of the electric light scheme, submitted by the Rural District Electricity Undertakings, Ltd., and given permission for the use of overhead and underground mains.

TRAMWAY and RAILWAY NOTES.

Accrington.—The borough electrical engineer, the town clerk and the chairman of the Electricity Committee have had a conference with representatives of the Haslingden Corporation, with a view to adjusting details in respect of the supply of energy for tramway purposes as given and metered at the Baxenden boundary, and it is understood they will be able to lay before the next meeting of the Committee terms for a more satisfactory adjustment of the matter.

Ayr.—The local tramway system is to be extended to the racecourse. The Western Meeting Club and the proprietors of Craigie and Auchincruive estates have agreed to give the necessary ground and road improvement alone costing £2,000.

Canada.—An electric railway, 29 miles in length, from Lacombe (Alberta) to Rimbey, *via* Gull Lake and Bentley, is projected. There will be four stations, each equipped with facilities for loading wheat.

During the first 10 months of 1912 over 1,500,000 passengers were carried on the Regina (Sask.) electric street cars, the fares paid being £15,030. The surplus on operation has amounted to £3,650, and, after paying interest charges, there is a net profit of over £1,600. The existing 14 miles of line will be extended in 1913, and the rolling stock triplicated. The city authorities propose to construct a spur line of the electric tramway to the proposed new garbage incinerator for the purpose of conveying street and house refuse

Brazil.—A contract has been signed between Dr. Carl Otto Jäckstein and the T.C. of Thomazina, province of Parana, for the installation of electric tramways between Mineira and the city, with branch lines to such points as are found necessary.—*Revue Pratique de l'Electricité.*

Continental Notes.—FRANCE.—On Saturday last traffic on the Paris Metropolitan Railway and tramways of the Eastern Co. was held up for two hours, owing to a short-circuit which occurred at the St. Denis generating station. This also affected the general lighting supply in the North of Paris, which was not restored to the normal until midnight. The situation has naturally provoked a good deal of criticism in the local Press.

The French Minister of Public Works has approved a scheme for the construction of an electric railway between Villefranche and Vernet-les-Bains (Pyrenees Orientales).

RUSSIA.—The *Frankfort Gazette* states that the St. Petersburg Municipality has decided to issue a loan of seven million roubles for the construction of tramways.

Dundee.—A proposal to rescind a resolution whereby £1,500 is charged against the revenue of the tramway department and placed to common good, led to an animated discussion at the monthly meeting of the Corporation. It was argued that any surplus should go towards improving the service, and that £1,500 a year would go a long way to enable the Corporation to extend the railless trolley system. The convener of the Tramway Committee hoped the Tramway Committee would be in a position before very long to make improvements on the service and yet continue to pay the £1,500. He also hoped the Committee would be asked to consider the question of extending the railless trolley system to Lochee. It was agreed to continue the payment.

Durham.—The United Automobile Service Co., Ltd., is introducing a motor service between Durham and Spennymoor and Bishop Auckland.

Fife.—Colonel von Donop inspected, and described as highly satisfactory, the new tramway from Lochgelly to Glencraig and Lochore last Thursday. The line is a continuation of the Dunfermline and Lochgelly system opened two years ago.

Glasgow.—The general manager and the town clerk are to report to the T.C. as to the advisability of acquiring, in connection with the tramway service, a number of motor-'buses for the purpose of (*a*) tapping the districts in the neighbourhood of the various tramway termini, and (*b*) being utilised for the conveyance of passengers in the city at night or early morning after the service of tramway cars has ceased. The Sub-Committee remitted the matter to the town clerk and the general manager for consideration and report.

Hastings.—The Hastings Tramways Co. is promoting a Bill in Parliament to enable it to adopt the overhead system on the Front line in lieu of the existing Dolter system. The matter was discussed at Friday's meeting of the T.C. A petition from frontagers strongly protested against the Bill, and appealed to the Council to oppose it. In the course of the discussion several speakers contended that the present system could be improved by better attention to the track, and it was argued that before overhead wires were approved, the company should carry out certain suggestions recently made by Major Pringle, of the B. of T., who came down at the instance of the Corporation. Eventually, by 22 votes to 9, the town clerk was instructed to take all necessary steps under the direction of the Law and Parliamentary Committee to oppose the Bill.

Huddersfield.—The Corporation is giving a trial to an improved cover for its tramcars. It has been constructed by the United Electric Car Co. from the designs of the tramways manager (Mr. R. H. Wilkinson). The cover can be fixed to the present cars, and will provide increased seating accommodation, comfort and freedom from draught. It is claimed that the cover will be a great improvement upon those at present in use.

Luton.—The T.C. has notified Messrs. Balfour, Beatty and Co., Ltd., that it requires them to take a further 10 years' lease of the electric tramways from February 21st next.

Irlam.—On Tuesday, last week, a deputation from the District Council waited upon the Tramways Committee of the Salford Corporation in support of the application for the extension of the Salford electric tramways from Peel Green to Irlam and Cadishead, which are developing into important industrial localities. Alderman Linsley, chairman, pointed out that the Salford Corporation could not entertain any such proposal unless the local authority was prepared to indemnify it against all loss. It would, moreover, want some profit. The deputation, of course, could give no such undertaking.

Lancaster.—At the annual meeting of the Lancaster and District Tramways Co., on Saturday, Mr. A. Bell, the chairman, said they were £600 worse off than in the preceding year, on account of bad weather and the cost of provender. So long as they retained horse traction, he said, they had reached the high-water mark, but the directors had given notice of their intention to apply for power to introduce mechanical traction, and the lines had been inspected by the Board of Trade.

London.—The Highways Committee has decided to remove and sell the four 3,500-KW. vertical-horizontal engine sets at the Greenwich tramways generating station, and to replace them with, in each case, an 8,000-KW. turbine. When worked entirely by turbines, the plant capacity will amount to 52,000 KW., as against at present 34,000 KW., there being four 5,000-KW. turbines installed, in addition to the reciprocating plant. The first section of the work, including the installation of two units, will be taken in hand immediately, and will cost £128,000; the second section is estimated to cost £99,000. On the basis of the present price of coal, 16s. per ton, the first section of work will result in a saving of £16,000 per annum in fuel, as well as a gain in capacity of 9,000 KW.

The L.C.C. on Tuesday adopted a recommendation of the Finance Committee that the scheme for a tramway from the Marble Arch to Cricklewood should be dropped, in view of the opposition of the various road authorities. The Council approved the General Powers Bill which includes various other tramway extensions estimated to cost £800,000.

Marsden.—The seal of the Council has been affixed to the agreement between it and the Huddersfield Corporation in connection with the extension of the tramways to Marsden.

Mytholmroyd.—A special meeting of the Council was held on Wednesday last week, when the prov. agreement drawn up by the Halifax Corporation, respecting the running of cars and motor-'buses in the D.C.'s area, was considered. Under this agreement, the Council agrees to postpone its right to purchase the tramway to 31 years from the passing of the proposed Bill; the Corporation agrees to run a motor-'bus to Cragg Vale upon certain conditions: that Councillor C. W. Greenwood deposit £100 in the bank in the name of the chairman of the Mytholmroyd D.C., and that the Corporation have the right to draw upon this sum in order to recoup itself of any loss which might be entailed by the running of the motor-'bus.

Oldham.—At the T.C. on the 4th inst., the Committee's action in not allowing whiskey advertisements on the tramways, was endorsed by 20 votes to 14, and Councillor Low remarked that the Corporation was throwing away £150 a year, and he would have been prepared to let the decision stand if it would make one fewer drunkard in Oldham, but it would not have that effect. The Deputy Mayor said a wealthy Corporation like Oldham should not do anything to encourage the drinking habits of the people.

Siberia.—The old tramway system in the city of Vladivostock has now been converted to electric traction. It is described as being the first electric tramway in Siberia.

South Africa.—The *British and South African Export Gazette*, referring to the matter of railless traction, says that Bloemfontein has already adopted a comprehensive scheme covering 11½ miles of route; Boksburg has just awarded contracts for a similar undertaking; Germiston has decided to inaugurate a service over a 7½-mile route; Benoni ratepayers have just approved a comprehensive scheme already adopted by the Council; and Krugersdorp has a scheme under consideration. The Johannesburg Corporation, however, has decided to inaugurate a service of motor-omnibuses instead of a railless system.

York.—In connection with the Bishopthorpe Road tramway extension scheme, the City Council has deferred consideration of tenders for the electrification in order that the city electrical engineer might prepare a report upon the cost of his department undertaking the work.

TELEGRAPH and TELEPHONE NOTES.

Dundee.—The Corporation, along with other representative bodies, is making renewed efforts to persuade the Postmaster-General to extend the underground system of telegraphs from Edinburgh to Dundee and Aberdeen.

Hong Kong.—The *Indian and Eastern Engineer* says that for the proposed wireless telegraph installation a sum of $100,000 is set aside. This is to be a station for ship-to-shore communication, with a range of not less than 600 miles. The proposed Imperial station is quite distinct from this scheme.

Imperial Wireless System.—On Wednesday last week the Select Committee on the Marconi contract continued the inquiry, Capt. E. F. Charlton, Assistant Director of Torpedoes at the Admiralty, giving evidence. The witness said that apart from the Imperial system, the Admiralty stations that would be necessary would not be long-distance stations except in the case of the Mediterranean and home waters. He could not over-emphasise the absolute importance of wireless telegraphy to the Navy, especially to the ships. If the Admiralty had constructed the stations, their staff would have been depleted, and it was very difficult to obtain suitable men. Asked why the Admiralty stipulated that applicants should have a University degree, he stated that they wanted men who had had a good engineering training. Their staff of wireless experts was only sufficient for experimental and naval work. While they were talking and holding inquiries, other nations were getting on with the work. He maintained that the agreement was a good commercial agreement. Government messages would be entirely free. It was a deplorable thing that the agreement had not been ratified long ago. He had no financial interest whatever in the Marconi or any other company.

Mr. P. Minter, Assistant Director of Navy Contracts, said the great aim of the Admiralty had been to secure a modification of the restrictions of Clause 9 of the 1903 agreement. The Admiralty approved of the agreement in its final form. He was not certain that the Crown clause in the Patents Act would have given the Government the right to use the patents for public traffic. If the contract had gone to someone else, the Marconi Co. might have set up competing stations and so prejudiced the chances of commercial success. The Admiralty had obtained freedom to communicate with other departments subject to certain restrictions, due to distrust on the part of the company, lest the departments should use the information obtained from the Admiralty without paying for it. He would like to see the inspection clause altered.

On Thursday Mr. Minter's evidence was concluded. He thought the right to reject plant considered by the Postmaster-General to be unsuitable was a valuable one. There was nothing in the agreement which conferred a monopoly upon the company.

Capt. Fitzmaurice, the representative of the Admiralty on the Cable Landing Rights and the Imperial Wireless Telegraphy Committees, said he thought that cables would ultimately be superseded by wireless telegraphy. He preferred a State-owned system, and regretted that an Admiralty scheme which he laid before the Cable Landing Rights Committee had not been put forward. The matter was still extremely urgent. We had not lost strategically, because we had not had a war. The urgency was on strategic grounds, but it did not matter, strategically, whether the stations were operated by the Admiralty or by a company. He had no interest whatever in the Marconi or any other company.

Col. Macdonogh, of the General Staff, who represented the War Office on the Committees, expressed similar views; he said that sites had been considered, and the work could be begun almost immediately. The matter was even more urgent now than in 1910. After the decision in their favour in February, 1911, the Marconi Co. had asked the War Office for royalties amounting to £20,000 down and £5,000 a year. The War Office offered £180 per station, which the company refused, and the matter was referred to the Treasury. For strategical reasons the War Office preferred simplex working. They had decided to concentrate their defence on the transmitting station, of the two duplex stations. The agreement met their requirements, and should be carried out. They could not agree to the inspection of any military station. He had no financial interest in the Marconi Co.

Major R. H. Boys, of the Engineering Staff of the War Office, gave evidence as to the question of patent rights between the War Office and the Marconi Co.

On Monday last the examination of Mr. J. E. Taylor, one of the staff engineers of the Post Office, occupied the sitting. The witness stated that on November 8th he informed the engineer-in-chief to the Post Office that he purchased 30 £1 shares in the Marconi Co. on December 21st, 1911, not then having any connection with the Imperial scheme. Later he thought that, for the sake of appearances, it would be wiser to part with them, and on March 19th he sold the shares, as well as 100 shares of the Canadian Marconi Co., which he had purchased on February 1st. He still held 200 £1 shares in the latter company, with which the Government had no dealings. He was in no way influenced by his holding in the company, as might be gathered from the tenor of his reports. He made this statement in advance, in order that the Postmaster-General might not be prejudiced before the Select Committee by his action.

At an interview with the Postmaster-General, on November 26th, he explained that he bought the shares because he believed them to be a sound investment, having a considerable knowledge of the Marconi Co. The Postmaster-General pointed out that he, being in a responsible position in charge of the staff concerned with wireless telegraphy, ought not to have purchased the shares. In a further statement to the engineer-in-chief he said he was not aware of any precedent which should have deterred him, as a Post Office servant, from making investments in a company contracting with the Government.

A letter from the Postmaster-General, dated November 13th, was read, in which he expressed his "grave displeasure" with Mr. Taylor's transactions; on December 15th, 1911, Mr. Taylor was present at a meeting of the Committee which was advising in the negotiations, when the subject of the contract was fully discussed, and on December 21st he bought 30 shares. He sold them on March 19th, 1912, when the price had increased 50 per cent. The Postmaster-General could not regard Mr. Taylor's explanation as satisfactory; such action was contrary to the traditions of the Civil Service, and tended to impair public confidence in its integrity. Had Mr. Taylor used his position to support the claims of the company his retention in the public service would have been impossible; but he was satisfied that he had not at any time shown any disposition to favour the Marconi Co., and, in view of that fact, and his honourable and very efficient service of 24 years, the milder course of reducing him to the rank of assistant superintending engineer would be followed.

The witness stated that he did not buy the shares on the faith of the Government contract. He bought 200 Canadian Marconis on July 15th last, which he still held. After the tender was accepted, he thought he would probably be engaged in the supervision of the work, and that his name had better not appear on the list of shareholders. There was no rule in the Post Office that he knew of against such transactions, but he thought it was desirable that some such regulation should be made.

Regarding the relative merits of the Marconi and Poulsen systems.

he said the latter was less liable to atmospheric disturbances, and would probably be more easily worked at a higher speed than the former. Assuming that the Poulsen system was reliable and could be worked over 2,000 miles day and night, it would be considerably the cheaper both in first cost and running cost.

Improved Telegraphic Apparatus.—Mr. Herbert Samuel, the Postmaster-General, recently stated that his department was experimenting between London and Liverpool with new machines which would send telegrams both ways simultaneously at the rate of 150 words a minute and transmit 1,000 telegrams an hour. The Department was taking measures further to improve the telephonic communication, and early in the New Year four additional circuits would be brought into operation between London and Liverpool.

Mongolia and Thibet.—Arrangements are in hand for the establishment of a system of telegraphs in Mongolia and Thibet. As it is expected the work will occupy at least three years, it is proposed, in order to furnish prompt and reliable information on the development of current affairs in these countries, to install for present use wireless telegraph stations in Urga, Uliasutia, and Kobdo, in Mongolia, and in Chamdo, Batang, and Lhassa, in Thibet.

Portugal.—Marconi's Wireless Telegraph Co., Ltd., has received information from Lisbon to the effect that Parliament has ratified the contract entered into with the Government, amounting to 2,006,000 fr., for the erection of wireless stations at Lisbon, Oporto, Azores, Madeira and Cape Verde.

The Telephone Service.—Mr. Bridgeman recently asked the Postmaster-General if it could be arranged that at all post offices where telephones for service purposes were installed, those telephones should be made available for the use of the general public at the usual charge. Mr. Samuel replied that this was being done. Nearly 200 such call offices had been authorised in the provinces since January 1st.

CONTRACTS OPEN and CLOSED.

OPEN.

Abertillery.—December 16th. 100-KW. Diesel engine and dynamo, water-cooling apparatus, pipework, overhead crane and switchboard panels and connections, for the U.D.C. See "Official Notices" November 29th.

Australia.—VICTORIA.—December 31st. Thirty detectors, for the P.M.G.'s Department. See "Official Notices" November 22nd.

January 10th, 1913.—Prahran and Malvern Tramways Trust (V.) invites tenders for trucks, wheels, axles, motor equipment and brakes. —*Australian Mining Standard.*

January 24th, 1913. Two 4,000-KW. steam turbo-alternators, for the Melbourne City Council. See "Official Notices" November 22nd.

January 28th.—Thirty-three miles of paper-insulated lead-covered cable for P.M.G., Melbourne. High Commissioner's Office in London, 72, Victoria Street, S.W.

January 28th.—Paper-insulated lead-covered cable for the P.M.G.'s department. See "Official Notices" to-day.

SYDNEY.—January 20th. Storage batteries, motor-generators and switchgear. City Electrical Engineer, Town Hall.

January 8th and 22nd.—Fifty induction motors (Specification No. 386); two turbine-driven centrifugal pumps (Specification No. 390). Chief Commissioner, New South Wales Government Railways, Sydney.

TASMANIA (HOBART).—January 13th. P.M.G.'s department:—Paper-insulated lead-covered cables. See "Official Notices" December 6th.

QUEENSLAND.—January 29th. Detectors (Schedule 242), for the P.M.G.'s Department. See "Official Notices" to-day.

VICTORIA.—February 21st. Four 1,500-KW. rotary converters, for the Melbourne City Council. See "Official Notices" December 6th.

Balderton (Notts.).—December 14th. The Parish Council invites tenders for an electrical installation for street lighting. For further particulars see this column for November 22nd.

Barton-on-Humber.—Wiring for electric light at Bardney Hall. Particulars obtainable up to, and including, Friday, December 13th, from Mr. A. Stamp, architect and surveyor, Ferriby Road, Barton-on-Humber.

Belfast.—January 1st. The Harbour Commissioners are inviting tenders for a 120-ton electric derrick crane at Alexandra wharf. Specifications, &c., from Mr. W. R. Kelly, Harbour Engineer, Harbour Offices, Belfast.

Belgium.—March 1st, 1913. The municipal authorities of Molenbeek St. Jean, Brussels. Concession for the supply of electrical energy for public and private electric lighting and power purposes in the town. Tenders to La Maison Communale, whence particulars may be obtained.

Blackpool.—December 17th. The Tramways Department is inviting tenders for a motor tower wagon. Mr. Charles Furness, Tramways Manager, West Caroline Street.

Bournemouth.—December 20th. Tramway clothing and caps, for the T.C. Mr. I. Bulfin, General Manager, Tramway Offices, Lansdown Crescent.

Dewsbury.—December 17th. Two water-tube boilers, superheaters, mechanical stokers, &c., for the Corporation electricity works. See "Official Notices" November 29th.

Dundee.—December 20th. 5,000-KW. steam turbine and alternator, condensing plant, and one 500-KW. rotary converter with transformer, for the Corporation. See "Official Notices" December 6th.

Eastbourne.—December 16th. 99 long-burning flame arc lamps for street lighting, and sale of 99 open-type double-carbon lamps to be displaced, for the Corporation. See "Official Notices" November 22nd.

France.—January 15th. Concessions for six railway schemes in the Department of Calvados, France, are offered for public competition. The lines are to be of 1 metre gauge, and the service is to be either electric or steam. For further particulars see this column for November 29th.

The State Railways Department are inviting tenders for the supply of 197 passenger coaches of various types. Particulars from the Bureaux du Service du Matériel et de la Traction, 44, Rue de Rome, Paris.

December 23rd.—The French State Railway authorities (Bureau du Service Electrique), 43, Rue de Rome, Paris, are inviting tenders for two sets of transformers at the electricity generating station at the railway station at Le Mans.

RENNES.—January 2nd. Tenders will be received for the supply of two switchboards for the Rennes railway station. Particulars from Bureau du Service Electrique (1e division), 43, Rue de Rome, Paris.

Germany.—SLAWENTZITZ.—December 15th. Offers required for the supply and erection of lightning conductors on 34 rural public school buildings. Particulars (70 pfennigs) from, and tenders to, Der Schulverbandsvorsteher, Slawentzitz O.S., Germany.

Hebden Bridge.—December 31st. One 240-KW. Diesel engine and dynamo, for the U.D.C. See "Official Notices" to-day.

London.—FULHAM.—January 9th. Steam dynamo, switchboard and connections for the Workhouse, Fulham Palace Road, W., for the Guardians. See "Official Notices" December 6th.

Manchester.—December 24th. (*a*) Three motor-'bus engines and chassis; (*b*) one motor-car. Mr. J. M. McElroy, General Manager of the Corporation Tramways.

New Zealand.—January 6th, 1913. Switchboards, for the Auckland Harbour Board. See "Official Notices" November 15th.

Ramsbottom.—The U.D.C. is inviting tenders for 3¼ miles of overhead electrical work. Specification and forms of tender (£5 5s., returnable) from the Clerk, U.D.C.

Spain.—The municipal authorities of Villacanas (province of Toledo) have just invited tenders for the concession for the electric lighting of the town during a period of 15 years.

South Africa.—December 31st. 107,580 yards of insulated wire, 6,336 yards of flexible wire, and 25 cwt. of bare copper wire, for delivery during February next. Tenders to Secretary to Tender Board, S.A. Railways Headquarter Offices, Johannesburg. Further particulars at the B. of T. Commercial Intelligence Department in London, and in the current *Board of Trade Journal*.

Switzerland.—BERNE.—The T.C. are about to spend 897,000 fr. on the purchase of additional rolling stock for the city tramways.

Warrington.—December 20th. Three motor-omnibuses for the Electricity and Tramways Committee. Tramways Manager, Car Sheds.

CLOSED.

Belgium.—Six German, two Belgian and one each French and British firms competed last week for two contracts for the supply of telegraph cable to the Belgian Telegraph Authorities. In one case the lowest offer was that of the Land und See Kabelwerke Gesellschaft, of Nippes, Cologne, and in the other the Rheydt Kabelwerke Gesellschaft, of Rheydt. Messrs. W. T. Henley's Telegraph Works, London, competed for both orders.

Bradford.—The Corporation has accepted the tender of Messrs. Ferranti, Ltd., for extra-high-tension switchgear for the 1,500-KW. rotary converter to be erected at Valley Road electricity works, at £166.

British Columbia.—The B.C. Electric Railway has ordered five electric locomotives from the Westinghouse Electric and Manufacturing Co.

Canterbury.—The T.C. has accepted the tender of Messrs. Chamberlain & Hookham for two battery meters.

Colchester.—The T.C. has accepted the tender of Messrs. H. G. Merry & Co. for 600 tons of Mansfield or Shirebrook nutty slack for the electricity works, at 13s. 10d. per ton, or, if the firm are unwilling to supply at that price, to accept the tender of Messrs. Cory & Sons, for Shirebrook nutty slack, at 15s. 2d. per ton

Dartford.—The U.D.C. has accepted the tender of the western Electric Co., Ltd., for cables and boxes, at £372; and that of the Woodville Electric Co., for wiring work at the electricity Works, at £88.

Doncaster.—In connection with the equipment for the Bentley tramways extension, the Tramways Committee has accepted the tender of the British Mannesmann Steel Tube Co. for light poles, at £5 11s. each, and for medium poles, at £7 11s. each.

Finchley.—Messrs. Francis Reade & Co. have received the order for the electric lighting work, bells and speaking tubes for block of flats and houses for the Brent Garden Village (Finchley), Ltd.

Glasgow.—The Works and Stores Committee of the T.C. has accepted the following offers:—

Gas heating appliances for Partick Depôt.—Corporation Gas Department.
Chip dryers.—Municipal Appliances Co.
Lead-covered cables.—National Conduit and Cable Co., Ltd.; Western Electric Co., Ltd.
Nidged Setts.—M'Creath, Taylor & Co.

Gosport.—For installing electric light at the new Stone Lane Council Schools, the tender of Mr W. N. Walters, of High Street, Gosport, has been accepted.

Hull.—The City Council has accepted the tender of Mr. P. T. Kettlewell, of Trinity Street, Hull, at £5,095, for extensions and alterations at the power station.

Johannesburg.—The electrical equipment of the Johannesburg Town Hall is to cost £5,536, the local contractors being Messrs. W. Haine, Ltd.—*British and South African Export Gazette.*

London.—WOOLWICH.—The B.C. has accepted the tender of Messrs. F. Wells for 1,500 tons of coal for the Plumstead electricity works, at 13s. 11d. per ton.

Messrs. Siemens Bros. Dynamo Works, Ltd., have obtained the contract for the supply of tantalum traction lamps for the Aberdeen Line of steamers for the year 1913.

L.C.C.—Messrs. Chamberlain & Hookham, Ltd., have received an order, *via* the British Westinghouse Co., for supplying car meters for the Woolwich section of the L.C.C. tramways. These meters are of a special design for working on the conduit system, so that the meter reads always forward on the counter, no matter in which direction the current passes through them.

The Highways Committee received the following tenders for two dynamometers for testing car motors at the central car repair depôt (third section):—

Buck & Hickman, Ltd.	(recommended) £528
Heenan & Froude, Ltd.	568

With reference to the Council's recent decision to keep the contracts for tramway tires, &c., in the hands of British firms, it is stated that the Council on Tuesday, after all, had to place part of the contract with a German firm, as the great activity in the British steel trade made delivery impossible in less than six or nine months.

The Stores and Contracts Committee has recommended offers from the following for acceptance for 1913:—

Electric insulating materials.—L. Andrew & Co.; Wm. Geipel & Co.; General Electric Co., Ltd.; J. N. Hardy & Son; J. G. Ingram & Son; Mianite and Insulators Co., Ltd.; Siemens Bros. & Co., Ltd.
Electric lamps.—A.E.G. Electric Co., Ltd. (carbon-filament lamps) (British); Brimsdown Lamp Works, Ltd. (metallic-filament lamps, with filament not of "drawn" wire) (British); Edison & Swan United Electric Light Co., Ltd. (metallic-filament lamps of "drawn" wire in one continuous length) (British).

Ramsgate.—The T.C. has acepted the tender of Messrs. Vitty & Hopper, of Ramsgate, for the installation of an electric fire call-bell system, at £106, with first year's maintenance, and £12 per annum maintenance, for seven years.

St. Helens.—The T.C. has accepted the tender of the British Insulated and Helsby Cables, Ltd., for 1,000 yd. of trolley wire for an additional feeder on the pole line to the Sherdley district.

Sheffield.—The City Council has decided to extend the contract with Messrs. A. Reyrolle & Co., Ltd., for the supply of 14 panels of extra-high-tension three-phase sub-station switchgear, to provide for a further 14 panels at the same price, viz., £1,682. The tenders of Messrs. T. A. Ashton & Co., Ltd., have been accepted at £121, and £76 for carrying out wiring and fitting work at the Penistone Road depôt, and installing electric light and bells at the Corporation Street baths, respectively. For supplying two water-tube boilers, together with chain grate stokers, superheaters and all accessories, spares, &c., the tender of the Stirling Boiler Co., Ltd., has been accepted at £7,790.

Shipston-on-Stour.—The B. of G. has accepted the tender of Messrs. Brown & Parsons, Ltd., of Leamington, for wiring and fitting the Workhouse for electric light, at £58, and to supply current at 6½d. per unit, or, alternatively, at £35 per annum for five years.

South America.—The Hart Accumulator Co., Ltd., have secured the contract for the supply of storage battery of 222, 700 A.H. cells and automatic reversible booster, for the Talcahauno Electricity Works, South America.

Stockport.—The T.C. has accepted the tender of Messrs. Bayliss, Jones & Bayliss, Ltd., for tie-bars for the tramways, at 1s. 7½d. each, and bolts and nuts, at £9 10s. per ton.

Stoke-on-Trent.—The B.C. has accepted the tender of Mr. Leonard Vaughan, of Hanley, for wiring Longton Town Hall, and supplying fittings, at £498. Messrs. Newton Bros. of Longton, tendered at £520. The Council has also accepted the tender of Messrs. R. Baker & Co. for 10 tons of steel tramrails (18 lb. to the yd.), at £5 15s. per ton.

Stretford.—The T.C. has accepted the tender of Messrs. G. Brady & Co., at £80, for the supply of an electric service lift.

Sunderland.—The Town Council, on Wednesday, accepted the following tenders:—

Cable Accessories Co.—72 sets street lighting fittings.
Ferranti, Ltd., and Reason Manufacturing Co., Ltd.—Meters.
W. G. Farrow & Co.—Cast-iron frames and covers.
British Insulated and Helsby Cables, Ltd.—House service fuse boxes, switch pillar, cable, &c.
I R.G.P. Co.—Service cable.
Reyrolle & Co., Ltd.—Oil switch.
British Westinghouse Co.—Three-phase E.H.T. meters.

Swansea.—The T.C. has accepted the tender of Messrs. Wm. Griffiths & Co., for extending the tramways through Castle Street to Harbour Road, Oxford Street and St. Helen's Road, at £6,226.

Walsall.—The T.C. has accepted the following tenders for annual supplies of stores to the Tramways Department:—

Anti-Attrition Metal Co., Ltd., trolley wheels.
British Insulated and Helsby Cables, Ltd., mechanical ears, section insulators air gap).
British Thomson-Houston Co., Ltd., controller fingers.
British Hele-Shaw Patent Clutch Co., Ltd., pinion wheels.
J. W. Caparn, malleable iron castings.
Edison & Swan United Electric Light Co., Ltd., "O.K." dry cells.
Electric and Ordnance Accessories Co., Ltd., arc lamp globes, "S.E." opal, and arc lamp carbons.
Fleming, Birkby & Goodall, Ltd., stranded wire.
Le Carbone, "S.S." carbon brushes.
National Rail and Tramway Appliances Co., Ltd., brake blocks.
Siemens Bros. & Co., Ltd., tantalum lamps.

Watford.—At the last U.D.C. meeting, a recommendation of the E.L. Committee, accepting the tenders of the British Westinghouse Co., Ltd., at £3,004, for a steam alternator and regulator, and the Electrical Construction Co., Ltd., at £103, for a generator, and additional feeding panels as required at the firm's schedule of prices, was adopted. In accepting these tenders the Committee protested against being compelled to adopt the general conditions of contract, as drawn up by the British Electrical and Allied Manufacturers' Association, such conditions, in the opinion of the electrical engineer, not being satisfactory from a practical engineering point of view.

West Ham.—The T.C. has decided to extend the contract for cable with the British Insulated and Helsby Cables, Ltd., for two years as from March 31st next, at the present basis charges.

York.—In connection with the Bishopthorpe Road tramway extension scheme, the City Council has accepted the tender of Mr. Wm. Dobson, of Edinburgh, amounting to £15,147, for the construction of the road track.

FORTHCOMING EVENTS.

Electro-Harmonic Society.—Friday, December 13th. At 8 p.m. At the Holborn Restaurant. Smoking concert.

Institution of Electrical Engineers (Students' Section).—Saturday, December 14th. At 7, for 7.30 p.m. At the Trocadero Restaurant, Piccadilly Circus, W. Annual dinner.
Wednesday, December 18th. At 7.45 p.m. At the Institution, Embankment, W.C. Paper on "Sterilization by Electric Light," by Mr. J. C. Rennie.

Junior Institution of Engineers.—Saturday, December 14th.—At 7 p.m. At Caxton Hall, Westminster, S.W. Reception, dance and whist drive.
Friday, December 20th.—Paper on "Electric Power Plant Troubles and Breakdowns," by Mr. E. F. Hetherington.

North of England Institution of Mining and Mechanical Engineers.—Saturday, December 14th. At 2 p.m. At the Wood Memorial Hall, Newcastle. Discussion on papers on "The Ignition of Coal-Gas and Methane by Momentary Electric arcs," by Prof. W. M. Thornton, and "Electrically-Driven Winding Engines in South Africa," by Mr. A. W. Brown. Exhibition and description of the "Ceag," "Stach," and "Tudor" miners' electric safety lamps.

Institution of Electrical Engineers (Newcastle Students' Section).—Monday, December 16th. At 7.30 p.m. At the Armstrong College, Newcastle. Paper, "Notes on Design and Running of the D.C. Sub-station," by Mr. H. D. Phelps.
Friday, December 20th.—At Tilley's Market Street Rooms, Newcastle. Annual Dinner.

Royal Society of Arts.—Monday, December 16th. At 8 p.m. Cantor Lecture on "Methods of Economising Heat," by Mr. C. R. Darling. Lecture III.

Institution of Sanitary Engineers.—Monday, December 16th. At 8 p.m. At Caxton Hall, Westminster. Sessional Meeting. Paper on "The Collection of Home and Trade Refuse," by Mr. J. O. Neumann. An electric furnace destructor wagon will be exhibited.

Institution of Electrical Engineers (Manchester Section).—Tuesday, December 17th. At 7.30 p.m. At the University, Manchester. Paper on "Electric Welding," by Mr. P. Bucher.

Institution of Electrical Engineers (Scottish Section).—Tuesday, December 17th. At 6.30 p.m. At the Grosvenor, Glasgow. Eleventh annual dinner.

Physical Society.—Tuesday, December 17th. At 8 and 7 p.m. At the Imperial College of Science, South Kensington, S.W. Annual Exhibition.

Institution of Electrical Engineers (Birmingham Section).—Wednesday, December 18th. Meeting at the University, Birmingham.

Institution of Electrical Engineers (London).—Thursday, December 19th. At 8 p.m. Paper on "The Work of the International Electrotechnica Commission," by Dr. S. P. Thompson.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, December 21st. Meeting. At 4.30 p.m. At the Royal Technical College, Glasgow.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—LIEUT.-COL. H. M. LEAF.

The following orders have been issued for the current week :—

Monday, December 16th.—"A" Company. Company training, 7 to 10 p.m.

Tuesday, December 17th.—"B" Company. Recruit training, 7 to 10 p.m.; company training, 7 to 10 p.m. Last recruiting night before the New Year.

Thursday, December 19th.—"C" Company. Company training, 7 to 10 p.m.

Friday, December 20th.—"D" Company. Recruit training, 7 to 10 p.m.; company training, 7 to 10 p.m.

Saturday, December 21st.—Headquarters will be open from 10 a.m. till 12 noon for regimental business only.

Headquarters will be closed from December 21st, 1912, to January 5th, 1913 (inclusive), except for busines of an urgent nature.

(Signed) P. H. CAMPBELL, Capt. R.E., and Adjt.,
For Officer commanding L.E.E.

NOTES.

The I.M.E.A. Convention, 1913.—The eighteenth annual Convention of the I.M.E.A. will be held in London from June 17th to 20th, 1913. The Council of the Institution of Electrical Engineers has kindly placed the Institution premises at the disposal of the Association for its meetings during the Convention. The headquarters of the I.M.E.A. Council will be the Hotel Cecil. As the Convention is being held during the height of the London season, members and delegates are strongly advised to make early arrangements for booking hotel accommodation. A preliminary programme will be issued early in the new year.

Carnegie Awards.—The Carnegie Hero Fund Trustees have made awards of £10 each to John Thompson and Mrs. Ross, who rescued, or attempted to rescue, victims who received electric shocks at Dingwall in August last, as already recorded. An allowance is also being made to the youngest daughter of Mrs. Grant, who was one of those killed.

Under the Round Table.—

THE "ELECTRICIAN."

A contemporary complains that the programmes of the Electro-Harmonic Society are not classical enough, and remarks :—"To perform two complete instrumental programmes would be enough to clear the King's Hall." Comment is needless.

THE CONTEMPORARY.

In a programme of but 11 *items, to perform two complete instrumental trios would be enough to clear the King's Hall.*

Comment is, indeed, needless!

Electricity Supply Rifle League.—The following are the results of the matches shot during November in connection with the above League :—Stepney (Barber 99), 555, *v.* Ilford (Brown 94), 541; Stepney (Jager 95), 546, *v.* Central (Law 97), 548; Westminster (Horley, W. and H. Pearman 96), 563, *v.* Ilford (Brown 96), 548; Westminster (H. Pearman 99), 570, *v.* Shoreditch (Weakes, East & Renvoyze 96), 569.

	Shot.	Won.	Lost.	Drawn.	Points.	For.	Against.
Westminster ...	8	8	0	0	16	4,541	4,395
Central ...	8	6	2	0	12	4,435	4,394
Shoreditch ...	9	5	4	0	10	5,043	4,972
Stepney ...	8	3	4	1	7	4,369	4,409
Ilford... ...	9	2	7	0	4	4,849	4,990
Hackney ...	10	1	8	1	3	5,426	5,503

Northampton Polytechnic Institute.—On Friday evening last the annual prize distribution took place at this Institute, in St. John Street, E.C. The awards were distributed by the Marquess of Northampton, after an appropriate address from Mr. Sebastian, the chairman of the Governors, and the reading of the annual report of the Principal (Dr. Mullineux Walmsley). A very attractive programme had been arranged, including organ recitals, lecturettes (kinematograph illustrations of twisting and breaking, by Mr. C. E. Larard, the head of the mechanical engineering department, and "Liquid Air," by Mr. W. M. Wilcox, lecturer in Applied Physics), visits to laboratories and workshops, and the usual gymnastic and swimming displays. In the course of his report, Dr. Walmsley said that the total number of students enrolled during the session was 2,012, as compared with 2,035 in the preceding session. The slight diminution was more than covered by a very special cause, namely, the diminution in the enrolments in the classes in telegraphy and telephony, owing to the state of unrest produced amongst the staffs of the telegraph department of the Post Office and of the National Telephone Co., owing to the absorption of the latter by the former. Apart from the disturbance naturally caused by such a large transaction and the additional work thrown upon numerous members of the staff, the position and prospects of a large section of employés were for a time somewhat uncertain, and in fact it might be said that things had not yet settled down to a condition of normal working, as shown by the fact that the classes in this particular department for the current session were smaller even than for the session under review. The day courses and classes have also been well maintained, especially in the engineering sections, in which, during the session, an exceptionally strong fourth year section was at work. For the eighth year in succession, the Principal was able to place without any payment of premiums the whole of the second and third year students in commercial workshops for the summer, and could have placed additional students had they been available. Still more important was the fact that the students who obtained the certificate for the four years' course in July had practically all obtained good starts in their engineering careers. A new departure in the day classes was the institution of morning classes in horology, following on an experimental and pioneer class of a similar kind, which was continued during the session in the electrochemistry department. The method of these classes is to take apprentices or boys of the apprentice grade for four hours every morning, on five days in the week, their afternoons being spent in the commercial workshops of their employers, for all the students were actually employed in commercial workshops. This meant a certain amount of sacrifice on the part of the employers, which not all were willing to make, but it was believed that the experience of those who had faced it showed that the arrangement could be made without serious detriment to the commercial work of the workshops. Dr. Walmsley felt that unless employers were prepared to make some sacrifices of this kind, the technical training of young apprentices in London could not be carried out under the best conditions, and it was hoped that in the future more employers would be disposed to make these sacrifices for the general advancement of the trades which were so important to them. As regards external examinations, five students of the engineering classes obtained the Degree of B.Sc. (Eng.) during the year, and three of these passed in Honours.

At the conclusion of Friday's proceedings, the Marquess of Northampton was presented with a specially bound copy of the syllabus by one of the students. The students' and members' conversazione was held on Saturday.

Strikes.—LIVERPOOL.—A Liverpool newspaper states that the men employed in the electrical departments of the shore gangs of several of the leading steamship companies of Liverpool came out on strike on December 4th, for an increase of wages to 39s. 9d. per week, and shorter hours. "At present the wages range from 36s. to 37s. 6d. per week. The companies affected are said to include the Cunard, White Star, Leyland, Pacific, &c. The notices expired yesterday."

THE CLYDE ELECTRICIANS.—According to a Glasgow paper, the Clyde members of the Electrical Trades Union, who have been on strike since November 18th, decided last week by 219 to 149 to adopt the recommendation of their Executive Council in favour of resuming work in the shipyards. The men asked that the "majority" rate in the shipyards should be 9d. per hour, but the employers refused to make any advance on the current rate of 8½d. "In consequence of the strike of shipyard electricians, the Electrical Contractors' Association decided to lock out the members of the Union who were employed in the building trade in Glasgow. These men have also been idle during the past fortnight. Their position was considered at a meeting of the Strike Committee, and it was agreed to issue an instruction to the men not to return to work until they have received the sanction of the Union officials. Unlike the men who have been on strike, those locked out have been in receipt of Union benefits."

Institution and Lecture Notes.—THE ROYAL INSTITUTION OF GREAT BRITAIN.—The following is a list of the arrangements for the Friday evening meetings before Easter, 1913 :—

January 17th, at 9 p.m.—Prof. Sir J. J. Thomson, "Further Applications of the Method of Positive Rays."
January 24th.—Prof. John Oliver Arnold, "Recent Advances in Scientific Steel Metallurgy."
February 14th.—Prof. Andrew Gray, "New Gyroscopes and their Applications."
February 28th.—Mr. C. T. R. Wilson, "Photography of the Paths of Particles Ejected from Atoms."
March 7th.—Prof. the Hon. R. J. Strutt, "Active Nitrogen."
March 14th.—Mr. A. E. H. Tutton, "Great Advance in Crystallography" (experimentally illustrated).

Other courses of lectures include the following :—

"Recent Research on the Gas Engine," by Prof. B. Hopkinson. Two lectures on Thursdays, January 30th, February 6th, at 3 o'clock.

"Surface Energy," by Mr. W. B. Hardy, Fellow and Tutor of Gonville and Caius College, Cambridge. Two lectures on Thursdays, March 6th, 13th, at 3 o'clock.

"The Properties and Constitution of the Atom," by Prof. Sir J. J. Thomson. Six lectures on Saturdays, February 8th, 15th, 22nd, March 1st, 8th, 15th, at 3 o'clock.

INSTITUTE OF MARINE ENGINEERS.—On December 2nd, Mr. A. E. Battle gave the concluding part of a lecture on "Wave Motion and Modern Developments in High-Frequency Electricity," illustrated with experiments.

JUNIOR INSTITUTION OF ENGINEERS.—On Wednesday the Presidential Address was delivered by Sir A. Trevor Dawson, R.N., M.Inst.C.E., on "Staff Officers in Industrial Works: their Scientific and Practical Training and Duties."

"Modern Developments in Electricity" was the subject of a lecture under the auspices of Edinburgh Typographia, by Dr. George A. Carse, who submitted a number of interesting experiments.

Inquiries.—Correspondents ask for the makers of "lubricon" and "Wilkins" heating apparatus.

Institution of Electrical Engineers (Western Section).—The first ordinary meeting of the Section in Bristol was held on Monday last, when Mr. T. Schontheil read a paper on "The Use and Design of Overhead Lines for the Transmission of Electric Power." A discussion followed, which was adjourned. A stroboscopic demonstration of phase shifting was given in the Electrical Engineering Laboratory of the University after the meeting, and an informal dinner party followed.

Institution of Civil Engineers.—The highest marks in the October Associate Membership Examination have been obtained by Mr. C. Quartanos, of Newcastle-on-Tyne, and Mr. H. Knowler, of Sutton, Surrey. The Council has accordingly directed that Mr. Quartanos, who is ineligible for the Bayliss Prize, by reason of his not being a present or former student of the Institution, receive honourable mention, and that the prize, of the value of £15, be awarded to Mr. H. Knowler, Stud.Inst.C.E., under the conditions of its foundation.

Tramway Social.—The Dunfermline and District Tramway employés held their annual social and dance on Thursday last week, when Mr. J. H. Shepherd presided over a gathering of 80.

Appointments Vacant.—The Government of India invites applications for the post of assistant foreman electrical engineer, for the Gun and Shell Factory at Cossipore; a resident electrical engineer is required, for the Todmorden Corporation (£150); switchman, for the Corporation Electricity Works, Newport, Mon. (25s.); assistant electrician, for the Posts and Telegraphs Department of the Gold Coast Government (£250); draughtsman and design office assistant, for the City and Guilds Engineering College, Exhibition Road, S.W. (£200). See our advertisement pages to-day.

Annual Dinner.—On Wednesday last week the staff of the Cleckheaton electricity works held their first annual dinner. Mr. A. Pickersgill (chief engineer) occupied the chair, and some members of the Council were present. The Chairman of the Electricity Committee (Lieut.-Col. Atkinson) urged the employés to pull together and so make the electricity undertaking a great success. A smoking concert followed, at which songs were capably rendered by Messrs. Pickersgill, McDowell, Kershaw and Fawcett, whilst Mr. J. Beckett gave an interesting exhibition of card tricks.

Electricity Works in Austria.—The Elektrotechnischer Verein, of Vienna, has sent us particulars of a statistical directory of all the public electricity works in Austria, which number about 1,000, and supply energy to almost twice as many towns and villages. The book is issued under the title "Statistik der Elektrizitätswerke in Osterreich," and contains the name and address of the proprietor of each undertaking, makers of the plant, population of the places supplied, system of supply, pressure, &c., and a variety of data relating to the conduct of the business. Information is also given regarding the Austrian electric railways, the towns that possess a supply of electricity, &c. The work will be published in January next, and those who apply for it before December 31st can obtain it for 2s. 9d. The address of the society is Theobaldgasse 12, Vienna VI.

Municipal Tramways Association.—At its meeting on Wednesday, the Sunderland Town Council agreed to invite this Association to hold its next annual conference at Sunderland.

Electrical Treatment Claim.—At the Birmingham Assizes this week, an action has been heard in which O. F. Freeman claimed damages from Dr. F. Hall-Edwards and Dr. E. Jones, for personal injuries sustained through alleged negligent electrical treatment of the plaintiff for analgesia. On Wednesday, after a full hearing, a special jury returned a verdict for the defendants.

Lock-out in Germany.—45,000 metal-workers have been locked out by firms in the Menden district. According to the *Morning Post* there have been differences between employers and employés in the Rhineland and Westphalian metal trades for some time, consequent upon the men's demand for a 50-hour week. The masters are only willing to concede a 57-hour week.

Educational Notes.—We have received from the "University Engineering College" particulars of the correspondence courses in electrical engineering and allied subjects which have been organised by the promoters; the syllabus comprises nine courses, intended to supply the needs of students in the various branches, and a special feature of the course is the fact that it is not limited to a fixed number of lessons, but is continued until the student is proficient. A number of scholarships are offered to students who enter for any course before December 31st.

Electrical Imports and Exports in November.—The trade returns for November show large increases in value in both imports and exports and re-exports. The increases in these three classes are respectively 8·5 per cent., 5·7 per cent., and 22·9 per cent.

Imports of electrical goods and apparatus, other than machinery and telegraph and telephone wire, amounted to £143,983 during the month, a decrease of £8,973. For the 11 months they were £1,320,182—an increase of £23,334 over 1911.

Exports of ditto were £304,409 for the month, a decrease of £15,775; and for the 11 months £4,049,758, an increase of £1,442,706 over 1911.

Imports of machinery advanced by £87,275 for the month, and by £890,569 for the 11 months.

Exports of machinery advanced by £34,060 for the month, and by £2,091,938 for the 11 months.

The B.A. Meetings, 1913 and 1914.—The Executive Committee for next year's meeting of the B.A. meeting at Birmingham was held the other day. The meeting will open on September 10th, with the presidential address of Sir Wm. White.

The *Times* publishes in its issue of December 4th some particulars relating to the Australian meeting of the British Association the year after next. It is expected that some 150 representatives of the Association, including Dominion and foreign scientists, will take part in the visit. The party will arrive at Fremantle on August 4th; Adelaide, Melbourne, Sydney, and Brisbane visits follow, the return to London being completed by October 11th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Parliamentary Committee of the St. Helens T.C. has recommended that the salary of Mr. J. W. Warr, outside superintendent of the electricity department, be increased from £180 to £200 per annum as from April 1st, 1913.

The Burnley Electricity Committee has recommended that the salary of the electrical engineer, Mr. Starkie, be increased £100 a year.

Mr. Bendix has been appointed assistant station superintendent (electrical) under the West Ham Electricity Department at a salary of £200 per annum, and Mr. J. Allan, now mechanical superintendent, is to be station superintendent at a salary of £350 per annum.

Mr. Reginald W. Klitz, who has held the post of mains engineer at Wimbledon electricity works for the past nine years, has been appointed chief assistant electrical engineer with an increase in salary of £25 per annum as from the 1st inst.

General.—The Norwich Corporation electricity staff has presented a barometer to Mr. S. J. Cooper, superintendent of the lamp department, who is leaving to go into business for himself.

Mr. H. W. Butler, engineer, of Craven House, Kingsway, London, W.C., who was chairman of the Executive Committee of the Electrical Exhibition, Olympia, 1911, informs us that he has taken into partnership Mr. S. L. Bentley, M.S.I.E., Paris, representative for many years of the Electrical Power Storage Co. in the North, Scotland and Ireland. Among the sole agencies held by the firm may be mentioned those for Crocker-Wheeler Co., electric plant, Temco electric drills, and Durvite case hardening compounds. They will continue to trade as manufacturers' agents, under the style of H. W. Butler & Co., and will be pleased to hear from firms wishing to be represented in London.

Mr. Henry Talbot, who has been manager of the Todmorden gas and electricity works for the last seven years, has resigned to take up the position of manager of the Holyhead Corporation Gas Works.

The daily Press states that Mr. C. A. Park has resigned his position of managing director to the British Westinghouse Electrical Manufacturing Co.

Mr. E. H. W. Westwood, honorary secretary of the Victorian Institute of Electrical Engineers, is returning to Australia, per ss. *Morea*, from Marseilles on December 20th.

Obituary.—Prof. Andrew Jamieson.—With great regret we announce the death, after a severe illness, of Prof. Andrew Jamieson, M.Inst.C.E., at Glasgow, on the 4th inst. He was born at the Manse of Grange, Banffshire, in 1849, being the eldest son of Dr. George Jamieson, of the Cathedral, Old Aberdeen. After a lengthy apprenticeship at the Aberdeen Ironworks, during which he attended the Aberdeen University, he gained a Whitworth Exhibition and the Sir John Anderson special prize for Applied Mechanics. For a time he occupied a responsible position with the Great North of Scotland Railway; in 1872, he was chosen by Sir W. Thomson (Lord Kelvin) and Prof. Fleeming Jenkin as assistant in the testing and subsequent laying of cables on the coast of Brazil, and later he became chief electrician abroad, between England and India, to the Eastern Telegraph Co., under Sir John Pender and Sir James Anderson, in which capacity he carried out special work during the Russo-Turkish war of 1878, connecting up the positions where the British warships were stationed. In the course of his work he visited almost all the countries between England and India, as well as North and South America and the East and West African Coasts, his last expedition being to the Cape in 1899 to investigate and report upon alleged interference between stray currents from the tramways and the submarine cables.

In 1880 Mr. Jamieson was appointed Principal of the College of Science and Arts, Glasgow, which subsequently, in combination with Anderson's College, formed the nucleus of the Glasgow and West of Scotland Technical College; in this institution he was appointed Professor of Engineering and chief of the Electrical Engineering department, positions which he held until his retirement in 1899. Prof. Jamieson was a most popular and successful teacher, and over 6,000 students passed through his hands, many of whom have since attained to positions of distinction; he took a keen interest in his pupils and in the members of his staff, and his kindly disposition endeared him to all who were associated with him as students or otherwise. He was also the author of numerous textbooks for the use of students, which ranked amongst the most

lucid and efficient of their kind, and of which over 150,000 copies were sold; the best known of his works amongst practical men is, no doubt, the "Pocket-book of Electrical Rules and Tables," which has always maintained its position in the foremost rank, and has passed through 19 editions.

Prof. Jamieson acted as consulting engineer in connection with many electrical undertakings, and as arbitrator in engineering disputes; in recent years he established a system of teaching engineering by correspondence, which attained to a considerable measure of success. He contributed to the *Proceedings* of the technical societies, and was awarded a Telford premium by the Institution of Civil Engineers, as well as the Gold Medal of the Institute of Engineers and Shipbuilders in Scotland. He was married twice, and leaves a widow.

MR. P. C. ROBERTS.—News received from South Africa brings the details of the death of Mr. Percy Claud Roberts, who had recently returned from a health trip. Mr. Roberts was stopping with some friends in Cape Town, and while showing them a Browning automatic pistol it accidentally exploded in his hands, and the bullet passed through his heart, killing him on the spot. Mr. Roberts was connected with several important works, and for the past four years had been chief electrician on the Giant Mine at Gadzoma. The climate of Rhodesia, however, wore him down, and in June last he was ordered by his medical adviser to take a trip to England. This he did, and had only been back in Cape Town a little more than a week when he met with the fatal accident, as described. He had resumed work in Cape Town the day before his death.

MR. WILHELM SCHARINA.—A Glasgow paper states that shortly after 11 a.m. on 7th inst. Mr. Wilhelm Scharina, of Messrs. Siemens Bros., Ltd., Glasgow, was found dead on the floor of a lavatory in the Central Railway Station, Glasgow. His son, by whom the body was identified, stated that Mr. Scharina had been affected with heart disease for ten years. He was 64 years of age, and resided at Mount Park, Gourock.

MR. ROBERT INGHAM.—The death took place on Thursday last week, at Devonshire Street, Skipton, of Mr. Robert Ingham, who had occupied the position of electrician at Belle Vue Mills, Skipton, for a period of 30 years.

MR. T. RAMSAY.—The death is announced, after a prolonged illness, of Mr. Thos. Ramsay, head of the firm of Ramsay Bros., electrical engineers, of the Phœnix Works, Albion Street, Whitehaven. Deceased, who was 68 years of age, established the business at the Phœnix Works with his brother, the late Mr. Wm. Ramsay, some 25 or 30 years ago, and since his brother's death, in 1901, he has been assisted by his sons, who will continue the business.

NEW COMPANIES REGISTERED.

Tramways, Light and Power, Ltd. (125,699).—Registered December 3rd, by Ashurst, Morris, Crisp & Co., 17, Throgmorton Avenue, E.C. Capital £600,000 in 300,000 preference, 200,000 ordinary, and 100,000 deferred ordinary shares of £1 each. Objects: To take over the undertakings of the Nottinghamshire and Derbyshire Tramways Co., the Derbyshire and Nottinghamshire Electric Power Co., the Leamington and Warwick Electrical Co., Ltd., and the Leicestershire and Warwickshire Electric Power Co., and to carry on the business of contractors for the construction and equipment of tramways and railways, with electric or other mechanical power, owners of tramways, light railways, and electric lighting and other works, &c. The signatories (with one share each) are:—Geo. Balfour, M.I.E.E., 22A, College Hill, E.C.; A. H. Beatty, 22A, College Hill, E.C., company director; W. Shearer, Swanton, King's Avenue, Bromley, Kent, company secretary; W. J. Selley, 36, Holmwood Road, Seven Kings, clerk; E. L. C. Feilden, 97, Gloucester Terrace, Hyde Park, W., Reserve of Officers; H. L. Williams, Brierwood, Worcester Park, engineer; A. S. Valentine, 87, Inderwick Road, Stroud Green, N., engineer. Minimum cash subscription, 100,000 shares. The signatories are to appoint the first directors; qualification, £250; remuneration, £1,000 per annum, divided between them.

Robin Electric Lamp Co., Ltd. (125,723).—Registered December 4th by Ashurst, Morris, Crisp & Co., 17, Throgmorton Avenue, E.C. Capital £75,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in incandescent electric lamps and gas mantles, burners and fittings for use in connection with electric light and gas, engineers, &c., and to adopt an agreement with R. F. Synd, Ltd. The signatories (with one share each) are:—A. J. Swan, 4, Sutherland Road, Chiswick, clerk; W. H. Walford, 239, Mortlake Road, Ilford, clerk. Private company. The first directors (to number not less than two or more than five) are to be appointed by the signatories. Remuneration as fixed by the company.

Birchington and Westgate Electric Light Co., Ltd. (125,675).—This company was registered on December 3rd, with a capital of £5,000 in £1 shares, to carry on the business indicated by the title, and to adopt agreements with Sir William J. Ingram, Bart., L. J. Simons and F. J. Cornford. The subscribers are:—Sir William Ingram, Bart., The Bungalow, Westgate-on-Sea, 1,000 shares; F. J. Cornford, Town Hall Buildings, Westgate-on-Sea, architect, one share. Private company. The number of directors is not to be less than three or more than five; the subscribers are to appoint the first; qualification, £50. Registered office, Town Hall Buildings, Westgate-on-Sea.

Ready Syndicate, Ltd. (125,671).—Registered December 3rd, by Courbold-Ellis & Mitchell, 14, Clements Lane, E.C. Capital, £10,000 in £10 shares. Objects, to carry on business as manufacturers of, and dealers in, electrical appliances or specialities, &c. Every subscriber for shares in the syndicate will be required, in respect of each such share, to underwrite or procure the underwriting at par of £85 shares of the proposed issue of £85,000 7 per cent. cumulative participating preference shares in a new company to be formed and called the British Ever-Ready Electrical Co. (1913), Ltd., or similar title. The signatories (with one share each) are:—L. R. Andrews, 53, Grandison Road, Clapham Common, S.W., clerk; G. T. Little, 7, Dornchffe Road, Fulham, S.W., clerk. Private company. The first directors are not named.

Voight & Haeffner (England), Ltd. (125,729).—This company was registered on December 4th, with a capital of £10,000 in £5 shares, to acquire inventions in relation to improvements in apparatus for the control of electricity. The subscribers (with one share each) are:—A. Haeffner, Renterweg, 82, Frankfurt o/M., general director: G. Cooper, Hampton-in-Arden, electrical engineer: M. Mueller, Falkstrasse, 23, Frankfurt o/M., director; M. Vogelsang, Borkenheimer Landstrasse, 101, Frankfurt o/M., director. Private company. The number of directors is not to be less than three or more than five; the first are A. Haeffner, chairman, G. Cooper, M. Mueller and M. Vogelsang (all permanent). Registered office, 95, Colmore Row, Birmingham. Solicitors, Lane, Clutterbuck & Co., Minories Chambers, Birmingham.

CITY NOTES.

British Columbia Electric Railway Co., Ltd.

MR. R. M. HORNE-PAYNE (chairman) presided on Tuesday at the Great Eastern Hotel, E.C., over the meeting of the above company.

The CHAIRMAN, who, in consequence of illness was unable to address the shareholders, had prepared his remarks, which were read by Mr. Blundell Brown. He said the accounts recorded another satisfactory year. Their two hydro-electric installations which had been so long under construction, and had involved the expenditure of such large amounts of capital, were beginning to earn money. In February last the first unit at Jordan River was put into operation, and it had successfully delivered power into the city of Victoria ever since with satisfactory results to the earnings of the Victoria branch. The second unit was also completed successfully about a fortnight ago, and they had commenced the work of increasing the water storage capacity, in accordance with the original plans, so that they might be able to gradually increase the electrical development unit by unit to its ultimate capacity of about 45,000 H.P. Thus they were providing in advance for the increasing demand for power in Victoria and the surrounding districts, where it seemed probable that trade of all sorts, and their business, would increase rapidly. Their great hydro-electric development at Lake Coquitlam and Lake Bunzen was described at some length in the annual report. (See ELECTRICAL REVIEW last week.) The completion of this mighty and costly enterprise was now well within sight, and it was safe to say that it would not only be one of the greatest developments in the world, but also one of the most satisfactory from the standpoint of producing cheap power and of requiring comparatively little expense for upkeep and maintenance. They would have been deriving some of the benefit of the increased storage during the past month but for the great delay in the manufacture of electrical machinery, owing to strikes in this country. The directors ordered this machinery so well in advance that it seemed impossible that it would not be ready and would not be delivered in time to assist in carrying the present winter load. In addition to these great engineering undertakings, the company had constructed new lines of railway in many directions, and had carried out improvements on its old lines, to meet demands of traffic, and it had greatly extended its light and power system. This work could not be described in detail, but it had involved large expenditure and a vast amount of thought and planning and work to the management and directors. There were two matters in connection with the company's affairs which had received a great deal of publicity in the Press, on which they would expect him to give some information. It had been stated that the company had entered into a contract for the purchase of power from the Western Canada Power Co. The facts were that the general manager of the Western Canada Power Co. approached the directors in an entirely businesslike and courteous way to ascertain whether the company would be prepared to purchase power from his company. The directors came to the conclusion that although the works at Lake Coquitlam would supply all the power they would need for several years to come, it would be wise to secure an alternative supply of power from the Western Canada Power Co., if it could be obtained cheaply enough. The subject was thoroughly discussed between the representatives of the two companies, but unfortunately the offer received from the Western Canada Power Co. was not acceptable to the company, and a counter-offer put forward by the directors had not been accepted by the Western Canada Power Co That was all there was to say on the subject. With regard to the long negotiations which had been reported in the newspapers between the municipal authorities of Vancouver and the company, the facts were as follows:—The area covered by what was really one great city, and which might be called Greater Vancouver, was for administrative purposes divided into the three municipalities of Vancouver, Point Grey and South Vancouver. The City of Vancouver originally covered a comparatively small area, and had been extended in recent years to include the areas formerly known as Hastings Town and District Lot 301. The company owned franchises empowering it to carry on its electric lighting and electric power business throughout the whole of the above-named municipal areas, as well as in many other districts, for very long periods. The company also owned franchises authorising it to carry on its electric railway business for long periods of years throughout the whole of the above-mentioned areas and districts, with the exception of the old, not the extended, City of Vancouver, where their franchise might be terminated by purchase on fair terms in 1919. In particular they owned franchises in Point Grey and South Vancouver which had still 37 years to run before these municipalities had their first option to purchase. At the end of 37 years these options occurred at intervals of 10 years in South Vancouver and Point Grey, and in the case of old Vancouver at intervals of five years after 1919. These franchises constituted the guarantees on the strength of which they had invested their money, and the directors were satisfied that they sufficiently protected the future. They had not initiated any steps to get them changed, nor had they asked for further advantages. In the last few years a desire had sprung up in Vancouver and Point Grey and South Vancouver to consolidate the three into one great city, and it was thought by some people to be desirable to at the same time consolidate the railway franchises within the three municipalities, so that they might operate under the same conditions and charge the same fares throughout the new city. They were first approached by the City Council of Vancouver on this subject some three years ago, and had every desire to meet the

wishes of the people fairly and even generously, but were compelled to break off the negotiations because they found that the opportunity was being taken to put forward a number of extravagant demands upon the company. They could not concede these demands, as, had they done so, they would have been unable to finance, and would actually have landed the company in bankruptcy, and they found that in refusing them they were making enemies who intentionally or unintentionally published statements which were utterly misleading—some of them grotesquely untrue—to the detriment of the business. On two subsequent occasions they had been approached by the city authorities and induced to reopen and to carry on exceedingly lengthy negotiations, but each time they had been compelled to withdraw for the same reasons, and at last they had to decline to again discuss the subject. A few weeks ago they received a written proposal from a Committee composed of representatives of the Councils of three Municipalities. The terms of this proposal being reasonable they accepted it, but were it not that they had desired to avoid the appearance of unreasonably standing in the way of the development of the city and the wishes of the citizens, he did not think that they would have accepted it. The terms included the consolidation of their franchises in these three municipalities into one franchise for a period of 25 years, and 5-cent fares throughout their area, an increase in the percentage on the railway earnings payable to the city, and the retention for five years of certain cheap tickets, a privilege which they had hitherto voluntarily conceded to the public, but which they had decided to withdraw in consequence of increasing expenses of every description in the Railway Department in Vancouver. This would have involved a considerable financial sacrifice to the company during the next seven years, and they would also have given up the last 12 years of their franchises in Point Grey and South Vancouver, and it was these last 12 years of the franchises which would be by far the most valuable years to them. On the other hand, they would probably have gained a further 18 years in the old city, which would have enabled them to better centralise on Vancouver their plans for the development of the surrounding districts, and they would have gained some other advantages. The Committee in due course reported to the Vancouver City Council, unanimously recommending their proposals, and requesting that they be laid before the ratepayers, but to their astonishment, and to that of everybody concerned, the Council did not approve of the arrangement, and summarily rejected a motion to instruct the city solicitors to prepare a by-law for submission to the people. This closed the matter. Their permanent stability as an enterprise was entirely unaffected by the failure of the negotiations. The position briefly was that the City of Vancouver could purchase in 1919 their lines within the original limits of the city (excluding their interurban lines), and no more. These lines comprised only a very small portion of their 280 miles of railway. In the districts recently annexed to the city their railway franchise covered a long period, and in South Vancouver and Point Grey their franchises had at least 37 years to run. Accordingly, if Vancouver exercised its option to purchase in 1919, people travelling between the outlying suburbs and the centre of the city must pay a double fare. He thought this was likely to be so objectionable to the people and so injurious to the business interests of Vancouver that the option to purchase in 1919 would not be exercised, and that they would continue to operate as at present throughout the city and surrounding areas for another 37 years, when South Vancouver and Point Grey would have their first option to purchase. Their lighting and power business was not touched in any way by these negotiations. In 14 years, they had grown from nothing to be the largest electrical enterprise in the British Empire, with probably one exception. They had expended $36,000,000 of cash up to the present. At a rough, but fairly reliable, estimate, the company had itself expended in wages since 1898 $14,430,000, not including contractors' wages. During the past year alone they had spent on capital and revenue accounts $12,564,717, of which $674,638 represented salaries of the local officials and staff and $3,676,720 the wages of other employés, leaving $8,213,359, a large proportion of which represented wages paid by contractors working for the company. The total number of employés on the company's pay-roll at June 30th, 1912, was 5,660, and the estimated number of employés paid through contractors was 2,500, making a total of 8,160 employés in the service. Assuming an average number of persons dependent on each wage-earner as 2, they had a total number of persons maintained by the British Columbia Electric Railway Co. directly, and through its contractors of 24,480, or 11 per cent. of the total population served by the company. At the end of 1898 they had 40 miles of track; to-day they had over 280. In 1898 they had 2,000 H.P. available; to-day they had 128,000 H.P. In 1898 they were operating 14 passenger cars; in 1908 they had 71; in 1909, 97; in 1910, 128; in 1911, 240; and to-day they owned or had under contract for prompt delivery 359 passenger cars. They had kept well ahead of developments by building lines into territories practically unsettled when they first went there, with the object of building up these districts, and they were giving a splendid service on several lines which did not even pay operating expenses. At the present moment they had extensive development plans mapped out which would benefit all concerned, and he would appeal to the common sense of British Columbians in their own interests to assist them in every possible way in their power, and to vigorously put down all such unreasoning opposition to their plans as was recently raised in connection with the Port Grey Franchise. With regard to the profits which they had made there was no secret. He had taken out the amount of cash invested in their enterprise in each year since 1898, and the amount paid out in dividends and interest. He found that only in one year, namely, 1902, had they paid more than 5 per cent. on the capital actually employed. At the end of the past year the amount of capital involved was $34,976,990, and the amount paid out, including the dividend which they were asked to declare that day, would be $1,457,190, or, say, 4¼ per cent. on the actual cash invested. Their enterprise had been carefully and patiently built up in a conservative and thoroughly sound way; their investment was, in the opinion of the directors, an absolutely safe one, and that they believed the success of the company was absolutely assured for many years to come.

MR. CAPEL CURE asked whether if the municipality did not exercise its right in 1919, their franchise would continue for 37 years, or would it have to be renewed from time to time. And further, what had happened with regard to the threatened competition they heard about last year?

MR. BROWN said their city franchise terminated in 1919, and after that in five yearly periods. With regard to the competition, they had experienced that for the past six months, and it had not shown any serious effect.

MR. DAVIDSON expressed the hope that the proportion of working expenses would be reduced when they got the great hydro-electric plant developed.

MR. BROWN said, of course they hoped it would be profitable, but whether the ratio of expenses would be decreased for some years they could not say, as in a new country the development was so large. All the time they were working with this object in view.

MR. C. W. BUTLER, speaking from experience, drew a very rosy picture of the future of British Columbia.

On the motion of MR. MORTON, seconded by MR. J. BUNTZEN, the report was adopted, and a further motion was agreed to for the payment of dividends at the rate of 6 per cent. on the preferred ordinary stock, and 8 per cent. on the deferred ordinary stock.

MR. HAROLD BROWN proposed that the best thanks of the meeting be given to the chief manager and officers and staff in British Columbia for their loyal and successful efforts on the company's behalf.

MR. T. BLUNDELL BROWN seconded the motion, and it was carried.

An extraordinary meeting was afterwards held, when a resolution was carried increasing the capital of the company to £4,600,000 by the creation of new shares of £1 each. Resolutions were also carried for the alteration of the articles of association, the object being to put beyond all possible question the right of the directors to make in the future, as in the past, simultaneous issues of preference, preferred and deferred ordinary shares.

Stock Exchange Notices.—The Committee have (1) appointed special settling days as under:—

Wednesday, December 18th.—Bonecourt Surface Combustion, Ltd.—33,642 shares of £1 each, 10s. paid (Nos. 1 to 33,642).

Thursday, December 19th.—Consolidated Cities Light, Power and Traction Co.—Fully-paid scrip for $4,000,000 first lien 5 per cent. gold bonds.

And (2) ordered the undermentioned securities to be quoted in the Official List:—

Consolidated Cities Light, Power and Traction Co.—Fully-paid script for $4,000,000 first lien 5 per cent. gold bonds.

Portland Railway, Light and Power Co.—$16,000,000 5 per cent. first and refunding mortgage 30-year sinking fund gold bonds (Series "A") (Nos. M1 to 15,400 of $1,000, D1 to 800 of $500, A to J1 to 200 of $100 each).

Underground Electric Railways Co. of London, Ltd.—Further issue of 12,000 shares of £10 each, fully paid (Nos. 47,698 to 50,692, 469,201 to 474,200, and 480,201 to 484,200); 14,568 "A" ordinary shares of 1s. each, fully paid (Nos. 1,135,910 to 1,150,477); and £80,298 6 per cent. first cumulative income debenture stock and £15,300 6 per cent. income bonds (Nos. 59,028 to 59,180 of £100 each).

North Berwick and District Electric Light and Power Co., Ltd.—At the first annual meeting, Prof. Schäfer, chairman, who presided, said that the shares allotted numbered 4,850. The contract for the erection of the power station had been given to Messrs. John Wilson & Sons, of North Berwick, and it was expected that the works would be completed within three months, and that by the spring a supply would be available for consumers.

British Electric Traction Co., Ltd.—The directors have declared the dividend for the half-year to September 30th on the 6 per cent. cumulative preference stock.

Consolidated Gas, Electric Light and Power Co. of Baltimore.—A dividend of 1¼ per cent. on the common shares (5 per cent. per annum) has been declared for the quarter ending December 31st.

Manila Electric Railroad and Lighting Corporation.—A dividend of $1½ per cent. for the quarter ending December 31st, on the capital stock is declared, also an extra dividend of $1 per cent., making a total of $2½ per cent. per share.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—The directors have declared an interim dividend for the quarter ended September 30th, of 2s. 6d. per share.

Winnipeg Electric Railway Co.—The directors have declared a quarterly dividend on the capital stock, exclusive of the recent issue of new shares, at the rate of 12 per cent. per annum.

Continental.—FRANCE.—The report of the Société d'Electro-Metallurgie de Dives for the last financial year shows a profit of £29,895. A dividend of 5 per cent. is being declared.

Western Telegraph Co., Ltd. — The directors have declared the first quarterly interim dividend of 3s. per share for the year ending June 30th, 1913, being at the rate of 6 per cent. per annum. The transfer books will be closed from December 14th to 20th.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

The directors' report for the year ending September 30th, 1912, to be presented at the meeting on Tuesday, December 17th, 1912, at 12 o'clock noon, states that the accounts show, after provision for doubtful debts, a net profit of £51,247. Adding £4,657 brought forward and deducting £9,375, the dividend on the preference shares paid in January and July, and £3,125, the preference dividend accrued to September 30th, there remains a disposable balance of £43,404, which, after providing for the proposed dividend on the ordinary shares, will leave £5,904 to carry forward. The directors recommend that the payment of the half-yearly dividend of 5s. per share, or at the rate of 5 per cent. per annum, be made to the preference shareholders, and that a dividend of 15s. per share, or at the rate of 7½ per cent. per annum, be paid to the holders of ordinary shares; both these dividends to be payable on January 1st prox. The general business of the company has been fully maintained. The price of its principal raw material had considerable and irregular fluctuations during the year, making the future position very uncertain, and there was a material decline towards the close. In March a general coal strike occurred, and July brought a London dock strike, which interfered both with the free delivery of the raw material which the company was receiving and the dispatch of its manufactured goods. The trading of the French factory and some of the foreign agencies has not been satisfactory, while other foreign agencies have produced quite gratifying results. The volume of the submarine cable work has increased, and the steamers, *Dacia* and *Buccaneer* have had employment. The *Silvertown* has just completed the laying of a submarine cable between Australia and New Zealand, and will probably leave for home towards the end of this month, when the contract period of guarantee should terminate. Profits in this branch of the business are somewhat severely limited by competition. The works at Silvertown and Persan have been maintained in the usual state of efficiency. The directors regret to record the death of Mr. B. Bishop and Mr. D. McNaught, the former having served the company since its inception and the latter for a period of about 25 years. Mr. J. Y. Buchanan resigned from the board at the beginning of the year.

Adelaide Electric Supply Co., Ltd.

The eighth annual general meeting was held on Tuesday at the offices, Finsbury Pavement House, Moorgate Street, E.C., Mr. J. B. Braithwaite presiding.

The Chairman said that they again had a satisfactory report. During the year they had expended £102,646 on capital account, bringing up the total cost of the undertaking to £485,619. That capital had been provided by the issue of the remaining £50,000 5 per cent. debenture stock, which was sold in the market on terms which gave them a profit of £1,454; and by the issue of a further amount of ordinary capital. The shares were offered at £8 each to the existing shareholders, and realised a profit of £29,595. They recommended that the whole of that £31,049 should be put to general reserve and that £3,720 be written off from certain special items in the capital account on the recommendation of the chief engineer. The auditors called attention to the fact that no provision had been made for depreciation. That, as he had told them on previous occasions, was a policy which the board felt bound to adopt, and instead of calling it depreciation, they were building up a general reserve which, with the sum to be added this year, would stand at the substantial figure of £37,329. The investments at cost, made on account of the dividend equalisation account, stood substantially at the prices at which they were purchased, and the account stood untouched at the figure of £25,000, as last year. Turning to the profit and loss account, owing to their losing the tramway load, which, in the previous year, produced a revenue of £30,841, they were very doubtful how the year would work out. They knew that their own business was rapidly increasing, but they felt that it would take them a year or two to make up for the tramway load. He was glad to say they had been agreeably surprised at the rapidity with which their own business had extended, and the result was that they had no need to trench upon the dividend equalisation account in order to maintain the same dividend as last year. The private supply had amounted to £48,647, as against £36,476, an increase of £12,171. The supply for power had amounted to £17,315, as compared with £14,140, an increase of £3,175, and other items in the revenue account, gave them a total of £73,154, against £86,347 in the previous year, an increase—excluding the tramway revenue—on their own business of £17,648, which he was sure they would all consider a most gratifying result. The generation of electricity had cost £18,253, against £25,791, a decrease of £7,538. They had an increase in general charges in Australia to meet of £1,885, and they had had to pay £6,875 interest on their debenture stock, against £1,250. The net result was that they carried forward to the balance-sheet £13,361 less than last year. That, however, still left them an amount which enabled them to pay 10 per cent. dividend on the ordinary shares, and a 2 per cent. bonus, and to carry forward a sum of slightly over £5,000. The increase in the business was shown at every point. The units sold had increased by 1,125,868, the increase being divided fairly evenly between light and power; the lighting increase was 30 per cent., and the power increase 38 per cent. They had had the advantage during the year of a visit from Mr. Wheadon, their chief engineer, and had had an opportunity of conferring with him in detail about the position in Adelaide, and they had also had Mr. J. K. Samuel, one of their local directors, over. They had adopted the policy of giving their consumers the full benefit of the metallic-filament lamp, which was equivalent to reducing the price of current 66 per cent., and he was glad to say that the policy had been crowned with success. He thought that the following figures as to the progress of the undertaking were really remarkable. The area of their district was now 155 sq. miles; an increase of 49 per cent. over last year. The population of the area that they supplied was 198,000, showing an increase of 10 per cent. The miles of street in their supply area was 245: an increase of 41 per cent. The capacity of their plant was now 3,500 kw., showing an increase of 23 per cent. The maximum load during the year showed a decrease owing to the loss of the tramway load; during the year they had connected to their mains no fewer than 3,058 new connections, a record which, he thought, it would be hard to beat even in any English supply company—an increase of 90 per cent., and the total number of consumers connected at the end of the year was 7,868, showing an increase of 63 per cent. He was glad to say that the development was continuing up to the present, according to the latest returns they had received from Australia.

Mr. Arthur F. Parish seconded the motion, and the report was adopted.

Isle of Thanet Electric Tramways and Lighting Co., Ltd.

The meeting of this company was held on Thursday last week at Winchester House, E.C., Mr. A. R. Monks, the chairman, presiding.

The Chairman, before moving the adoption of the report (see Electrical Review, page 924), explained that he was occupying the chair because he had been elected by his colleagues on the resignation of Lord Arthur Butler, who, having been chairman of the company since its inception, felt that the time had come when he should be relieved of some of the more arduous duties appertaining to the chairmanship. He (Mr. Monks) and the other directors pointed out to Lord Arthur that he had piloted the company into a more successful position than it had occupied for some years, and that it was a pity he should retire now, but his lordship replied that that was exactly the reason he had taken the step. Coming to the accounts the capital and the loans remained the same; but the creditors had increased by £4,610; which was attributable to further expenditure on plant and mains. During the year they had paid off one creditor's balance of £1,000. On the other side of the balance-sheet it would be noticed that they had expended four sums aggregating £9,440 as follows:—additional machinery, £1,881; new sub-station at Broadstairs, £4,177; electric lighting installations, £3,303, and a small sum of £137 on street lighting. On the revenue side there was a decreased profit of £2,116. The decrease in the receipts from traction amounted to £2,683, but there was an increase in lighting of £1,684, and the expenditure had increased by £1,181. The decrease in the tramway receipts arose from the disastrous summer weather. As they were aware the undertaking was a fair weather line, and he did not suppose a more unfortunate state of affairs was possible than that which they had to contend with during the summer. Their season was mostly in August and September, and it rained every day in the first month and nearly every day for the first two or three weeks in the latter, and when the weather took a change for the better it was too late for them to reap the advantage, as the visitors had gone home. The lighting receipts, he was glad to say, showed an improvement of some 24 per cent. over those of the previous year. The extra expenditure was practically all due to the increased cost of coal and coke—coal having increased 4s. 3d. a ton and coke 3s. 8d. The strike also affected them somewhat, as they were forced to use the best coal instead of coke, but they kept up their service and gave an unlimited supply of light. As to the future, in the coming year they would have to spend considerable sums on further plant. They had contracted for a new Diesel engine which they expected to be delivered about next June, and with an additional expenditure of some £7,000 or £8,000 he hoped they would be able to meet all the demands upon them for lighting, and that they would be free from any further material capital expenditure in the future. Of course there would always be expenditure for mains, and fortunately that was so, because it was to their lighting business that they would have to look for dividends. He would liked to have met the shareholders with an increase in the dividend this year, but in view of the finances, and seeing the importance of progressing with the lighting part of the undertaking, that was not possible.

Mr. W. M. Murphy seconded the resolution.

The Chairman, in reply to questions, said he did not think the board had put too much towards the maintenance of the permanent way. That was one of the most serious problems they had to face, especially as the company got older, and they must remember that in the early days they were not able to do what they ought to have done in that regard. They certainly hoped for great economies in working when they got the Diesel engine in operation.

The report was adopted.

Melbourne Electric Supply Co., Ltd.—The directors have declared a final dividend of 5 per cent., making 7½ per cent. for the year, together with a bonus of 1 per cent., both free of income-tax, on the consolidated ordinary stock, in respect of the year ended August 31st.

Shawinigan Water and Power Co.—A dividend of 1¼ per cent. on the common shares (6 per cent. per annum) is declared for the quarter ending December 31st.

Metropolitan Electric Tramways, Ltd.

Mr. Emile Garcke presided on December 4th at the Holborn Restaurant over an informal meeting of the shareholders of the Metropolitan Electric Tramways, Ltd., called to hear an explanation of the proposals recently made by the London and Suburban Traction Co.

The Chairman said that the proposal which they had received to exchange their preference, ordinary and deferred shares into debenture stock and shares of the London and Suburban Traction Co., was an offer which was made by the new company to each individual shareholder in their company, and it was open to the shareholder to accept or decline it, as he thought fit. The formation of the Tramways (M.E.T.) Omnibus Co. led to negotiations with the Underground Railways Co. of London, who controlled the L.G.O.C. and held the majority of the ordinary shares in the London United Tramways. These negotiations had resulted in the present proposals. The three companies in which they were interested, namely, the Metropolitan Electric Tramways, Ltd., the Tramways (M.E.T.) Omnibus Co., and the North Metropolitan Electric Power Supply Co., would each continue to have a separate existence as before, but the London and Suburban Traction Co. would, if the scheme became operative, be the holders of preference shares and ordinary shares in the Metropolitan Electric Tramways and the whole of the ordinary shares in the Tramways (M.E.T.) Omnibus Co., and the shareholders would become shareholders in the London and Suburban Traction Co. But the debentures of the Metropolitan Electric Tramways Co. were not interfered with by the scheme, and for the present the debentures issued by the M.E.T. Omnibus Co. would remain unaffected. Further, no change whatever would take place in regard to the North Metropolitan Electric Power Supply Co. If the scheme became operative, the capital of the London and Suburban Traction Co., Ltd., would consist of £550,000 4½ per cent. first mortgage debenture stock, £1,500,000 5 per cent. cumulative preference shares of £1 each, and £1,750,000 ordinary shares of £1 each, the preference shares having priority as to capital over the ordinary shares. If he assumed for a moment that all the shareholders in the Metropolitan and London United Companies accepted their offer of exchange, the capital of the new company which would have to be issued in exchange for the shares in the two tramway companies would be: £200,000 in 4½ per cent. first debenture stock; £1,449,336 in 5 per cent. preference shares; and £1,749,336 in ordinary shares. They would observe, therefore, that whereas practically the whole of the preference and ordinary share capital would have to be utilised for the scheme, there would be a balance of £350,000 debenture stock available for purposes other than the exchange. It was intended that this £350 000 debenture stock should be issued to the public and the proceeds of the issue applied to paying the expenses of, and incidental to, the formation of the new company and the carrying out of the scheme, the purchase of the share capital of the Tramways (M.E.T.) Omnibus Co., Ltd., and providing the last mentioned company with funds required for completing its fleet of 350 omnibuses, and building and equipping the necessary garages. The preference shares which they now held in the Metropolitan Tramways Co. were £1 each, and were entitled to a 5 per cent. cumulative preferential dividend and to priority of capital over the ordinary shares. The holders of these shares were invited to exchange them for debenture stock and preference shares in the new company, receiving 40 per cent., or 8s. per share, in 4½ per cent. debenture stock and 70 per cent., or 14s. per £1 share in 5 per cent. preference shares. They would therefore receive 22s. of new capital in exchange for 20s. of present capital and their revenue would also increase. In future they would receive £5 6s. per cent. per annum instead of £5 per cent. as at present. With regard to the ordinary shares of the Metropolitan Tramways Co., which were £1 each, and which received a dividend last year of 6 per cent.—the holders of these shares were invited to exchange them for £1 of 5 per cent. preference shares and £1 of ordinary shares of the new company. They would therefore receive a bonus in new capital of 100 per cent., or, in other words, double their present holding. On one-half of this new capital they would receive a fixed cumulative preferential dividend of 5 per cent. On the other half, or the bonus capital, they would receive such dividend as might be distributed on the ordinary shares of the new company. With regard to the deferred shares, the offer to the holders of these shares was on the basis on which they had been placed by the recent resolutions passed by the company, authorising the conversion of the deferred shares into ordinary shares in the proportion of four deferred shares to one ordinary share; *i.e.*, under the present scheme the deferred shares would receive as to one-fourth, exactly the same terms as were offered to the ordinary shareholders. The proposal to convert the deferred shares into ordinary shares was still awaiting the approval of the Court; but the holders of the deferred shares who accepted the offer of the London and Suburban Traction Co. would at once place themselves in the position which they would occupy if the approval of the Court had already been obtained. The chairman next referred to the terms offered by the new company to the London United Tramways Co. in so far as they affected the position of the shareholders in the Metropolitan Co. It might be asked how was it that the position of each party to the bargain could be improved without either making a sacrifice to the other. The answer was that this double advantage would be secured by the consolidation of interests which the scheme proposed to establish. In the first place, they hoped to be able to effect considerable economies by joint management, through bookings, and generally by establishing a community of interests, with results which it might be difficult to express in figures at this stage, but which they with their knowledge of the business felt confident could be brought about. But more important still would be the profits which the new company would earn from the operation of 350 motor-omnibuses to be provided by the Tramways (M.E.T.) Omnibus Co. It might be said that these omnibus profits belong to the Metropolitan Co., and that by allowing them to come into the joint account, the London United Tramways shareholders would be participating in profits which at present belonged exclusively to the Metropolitan Co. This was perfectly true in a way, but shareholders in the Metropolitan Co., must understand that if the scheme did not go through, they would not be able to run 350 omnibuses in the metropolis without exposing them to severe competition, and that the omnibuses in that event would not then earn what they would earn when under the control of the new company. Moreover, competition of motor-omnibuses with their tramways would be still further increased, and altogether the shareholders in this company would not be in as good a position as they believed they would be if they made the exchange and the scheme became operative. He laid particular stress upon this point, because the experience they had already had of the competition compelled him to tell them that the prospect of a bitter warfare between powerful rival interests was certain to involve both companies in heavy loss, without advantage to the public or anyone else. He was sorry to say that the profits of the Metropoliton Co. during the present year had already been materially reduced by omnibus competition, and if it were not for the steady improvement in their electric power business, he would have to prepare them for a serious reduction of dividend. As it was, some reduction of the ordinary dividend was inevitable, but those shareholders who accepted the exchange of shares would be more than compensated for this in future years by the bonus of capital they received from the new company. Continuing, the chairman pointed out that the traffic problem and the competition which the company had to face were peculiar to London, inasmuch as the tramway did not cross the central parts of the Metropolis, and hence the omnibuses had exceptional advantages. They had good grounds for believing that provincial tramway undertakings were not exposed to the same competition from motor-buses. It was sometimes thought by those who were solicitous for the interests of the public, that combinations of the kind proposed, meant increased profits to the capitalists at the expense of the travelling public, but in this case one could say with confidence that the result of combination and co-ordination of travelling facilities would be to produce greater benefits for both the travelling public and the shareholders. Coming to the question of what were the prospects of the new company earning sufficient profits to pay fair dividends on its capital, he said, in the first place, they must realise that there was no watering of capital in the scheme. Although the Metropolitan Tramway preference and ordinary shareholders received a bonus in new capital, the capital of the new company would not be greater than the combined present capital of the companies. This result arose from the fact that while the Metropolitan Co. shareholders received more than par, the London United Tramways shareholders received less than par. The maximum subscribed share and debenture capital of the new company to be issued under the scheme of exchange would be £3,398,672, as against the present issued capital of the two tramway companies who were parties to the arrangement, of £3,459,848. The profits of the new company would be derived from the dividends which it received on the shares it held in the Metropolitan and London United Tramways Companies, and also in respect of the whole of the ordinary shares in the (M.E.T.) Omnibus Co. Of course, it was difficult to gave an exact figure, because they did not know what proportion of the present capital would be exchanged, but there could be no doubt whatever that shareholders who did exchange would receive a larger share of the profits than the shareholders who stood out, because if the scheme became operative, the new company, by reason of holding the whole of the shares in the (M.E.T.) Omnibus Co., would receive the whole of the net profits on the working of the 350 omnibuses, while the shareholders in the M.E.T. Co. who did not exchange would, unfortunately, but unavoidably, suffer a diminution of profits by reason of some motor-omnibus competition — for, however much the tramways and omnibus interests might work together, the tramways would certainly have to give up some of the traffic to the omnibuses. Assuming, for the purpose of an estimate, that the whole of the shareholders in the Metropolitan Co. and in the London United Tramways Co. exchanged their shares for shares in the new company, then the new company would receive the whole of the tramway profits of those companies, after paying interest on the existing debentures, and in addition to these profits the new company would have the profits from the working of 350 omnibuses. Of course, it would be some time before this number of omnibuses were in operation. They were being delivered now in batches, but it must take nearly 12 months before the full number could be placed in public service, and by that time the conditions might not be the same as at present. It would therefore be unadvisable, or rather impossible, for him at this juncture to make any definite estimate of the dividend which would be paid on the new ordinary shares. They had taken every possible precaution to protect the shareholders' interests, and the arrangement they had made with the L.G.O. Co. was that the new company should receive the average receipts per omnibus of the L.G.O. Co.'s fleet in the metropolitan area, and there were other respects in which the terms were advantageous to them as shareholders. The directors therefore had no doubt whatever that the holders of the preference shares in the Metropolitan Tramways Co. who made the exchange would receive their £5 6s. per cent. in future, which was more than they were receiving at present, and that the holders of the Metropolitan ordinary shares who made the exchange would receive 5 per cent. on one-half of their new shares, and also

a fair dividend on the other half, or bonus portion of their new capital, but what the dividends on this bonus capital would be it was not easy to say with any certainty at the present moment. Another advantage of making the exchange was that, inasmuch as the new capital would be a combination of the capital of two separate companies, there would be a better market for the new shares. On the whole, the scheme had been well received, and the number of assents which had already come in was considerable; but he feared that some of the shareholders had not fully understood the scheme. Mr. Devonshire, their managing director, was managing director of the new company, which included the L.U.T. He had also joined the board of the new company to represent their interest, and the Tramways (M.E.T.) Omnibus Co. had appointed another director (Mr. Soames). The L.U.T. Co. was represented by Mr. Acworth, the chairman of that company, and by Mr. Stanley, who was managing director of the Underground Railways Co. of London and of the L.G.O. Co. Mr. Barber, their secretary, was secretary also of the new company, and the whole organisation of the new company was designed with a view to securing unity of interests between the various tramway and omnibus undertakings, which at present provided so great a part of the traffic facilities of the metropolis.

MR. ENNIS asked if the burden of the arrears on the London United Tramways 5 per cent. cumulative preference shares would be a burden on the new company, and what proportion of shareholders had already expressed their approval of the scheme.

The CHAIRMAN said the arrears of interest on the London United shares would not be the concern of the new company, and would have to be dealt with by the London United Co. in their own way. Assents were coming in continuously, and he had not exact figures before him. In the case of the M.E.T. ordinary shares, they had already a very large majority, and the same remark applied to the deferred shares, and also to the ordinary and preference shares of the London United Co. With regard to the Metropolitan Electric Traction preference, they had a large holding, but not the necessary proportion at present.

MR. BALDWIN contended that they were parting with a very valuable and improving asset in the North Metropolitan Electric Power Co. The preference shareholders felt that the new security offered to them in exchange for their present holdings was not of that value estimated by the chairman, who was generally such an optimist. Then he considered the value of the new security was somewhat sapped by the power of the new company to issue £550,000 of debentures, whilst they were also putting nearly £2,000,000 of debentures of the London United Co. in front of their security. He did not see where it was to the interest of the preference shareholders to share in the undertaking of the London United Co.

MR. ENNIS asked what area was meant when the chairman said the new company would receive a proportion of the omnibus earnings in the metropolitan area.

The CHAIRMAN said it meant the County of London area plus the areas served by the Metropolitan Electric Tramways and the London United Tramways—a very valuable concession. Mr. Baldwin's points were good, but it was not true to say that they were parting with the North Metropolitan Power Co. The only way in which it was affected, was that new interests were introtroduced into the holding company, but the other interests would rank after theirs. There was no sapping in value by the new company having the power to issue debentures. £200,000 of these debentures would go to the preference shareholders, and the remaining £350,000 were for the payment of the omnibuses, and if the holding company did not provide that money, it would have to be provided by the M.E.T. Tramways Co. Consequently, they were no worse off. It was an economical financial arrangement for the purpose of raising capital in the most convenient and the cheapest possible way.

MR. BALDWIN raised the question of the quoted price of the shares, but

The CHAIRMAN pointed out that he attached no great value to the recent Stock Exchange fluctuations. At the same time, if they did take Stock Exchange quotations, they were higher in consequence of the scheme than before.

MR. ENNIS remarked that they were all acquainted with the broad facts of the situation in London. They found the London County Council, which pushed the old tramway companies into a corner, were now feeling the pinch themselves. He regarded the present scheme as one of self-defence, and after hearing the chairman, would support it.

MR. DADE moved: "That this meeting of the Metropolitan Electric Tramways Co. approves of the scheme for the consolidation of the interests of the Metropolitan Electric Tramways and the London United Tramways, and recommends the shareholders to exchange their holdings in accordance with the directors' circular of November 25th, 1912."

MR. PARKER seconded the motion, and it was carried unanimously.

Manx Electric Railway Co., Ltd.—The directors have declared a dividend of 5½ per cent. per annum on the preference shares. £1,000 is placed to reserve for special renewals, and £920 is carried forward.

China Light and Power Co.—The net profit for the past year is nearly $16,000, an improvement of over $10,000 on the previous year. No dividend is to be paid, and $10,000 is to be devoted to depreciation on machinery.—*Indian and Eastern Engineer.*

Prospectuses.—*Tramways, Light and Power Co., Ltd*—A prospectus has been advertised this week inviting subscriptions for 300,000 6 per cent. cumulative preference shares of £1 each at par. The company has been formed to acquire and work various concerns in the counties of Derby, Nottingham, Leicester, and Warwick, namely, the Derbyshire and Nottinghamshire Electric Power Co.; Nottinghamshire and Derbyshire Tramways Co.; Leicestershire and Warwickshire Electric Power Co.; and Leamington and Warwick Electrical Co., Ltd.; the amount payable being £220,600 (£90,600 in cash, £45,000 in ordinary shares, and £85,000 in deferred ordinary shares). Contracts have been entered into with Messrs. Balfour, Beatty & Co., Ltd., for the construction and equipment of 13½ miles of single tramway track between Ripley and Nottingham, and for the extension of the power plant and distributing system of others of the undertakings mentioned. £150,000 will be issued in 5 per cent. debentures or debenture stock at a later date. A report by Mr. W. C. C. Hawtayne estimates the net earnings of the undertakings at £46,500, and after paying debenture interest and preference dividend, he shows a surplus of £21,000. The operating management of the properties will be in the hands of Balfour, Beatty and Co., Ltd.

The British Electric Transformer Co., Ltd.—This company is offering for subscription an issue at par of 42,286 6 per cent. cumulative preference shares of £1 each. The list is to close to-morrow (Saturday). The increase in the company's business for Berry transformers, "Tricity" cookers, and other electric appliances necessitated the provision of additional manufacturing capacity last year, so that the largely increased turnover might be handled economically. The works were, therefore, extended, and it is chiefly the cost of the new factory and its equipment that has called for the provision of further working capital, which the present issue will produce. In anticipation of this issue 18,000 preference shares were subscribed for and fully paid up in August last, and arrangements have been made under which applicants can purchase these with the benefit of the dividend accruing thereon.

Dorsetshire.—The County of Dorset Electric Supply Co., Ltd., has been formed to deal with the as yet unexploited field for electric supply in Dorsetshire. A good number of towns in Dorsetshire are without electric supply, and this company proposes to operate over a wide area, covering Dorchester, Sherborne, Wimborne, Swanage, Blandford Forum, Wareham, Bridport, Shaftesbury, and other towns. The majority of the directors are Dorset men, and support in raising the necessary capital is anticipated from the county. The prospectus, we are informed, is being issued this week, and we understand that it includes a favourable report by Mr. W. C. C. Hawtayne. The company takes over one going concern, the Lyme Regis Co., which paid 4 per cent. in its second year of working, after placing an equal sum to reserve. Two of the directors are connected with existing undertakings, *i.e.*, Dr. J. H. Hosker, who is a director of the Bournemouth and Poole Electricity Supply Co., Ltd., and Mr. F. W. Reynolds, who is a director of the County of London Company, the City of London, and other companies.

Power-Gas Corporation, Ltd.—The directors report that the works of Ashmore, Benson, Pease & Co., have been maintained in a condition of efficiency and repair during the year, and all expenditure for this purpose has been charged to revenue. The coal strike caused a serious reduction in output of the works and greatly retarded the execution of contracts. The profits for the year are substantially less on this account. The results of the year's trading to September 30th of the Power-Gas Corporation, Ltd., show a total profit of £11,852, plus £3,264 brought forward, making £15,116. The directors propose to apply to reserve fund, £2,000; dividend at 4 per cent. per annum upon the ordinary shares, £9,984; to be carried forward, £3,131.

STOCKS AND SHARES.

Tuesday Evening.

STOCK Exchange markets are moving in zig-zag fashion, the brightness of one day being dimmed by some rumour or other on the next. Business is very fitful, as is only to be expected a fortnight before Christmas, and prices have been depressed by fresh foreign-political fears. The sensation of the week, so far as electrical markets are concerned, was a steep slant in National Telephone Deferred stock. Part of the fall was subsequently recovered.

The market for English Electricity Supply shares continues very hard. It does not, however, take much to move prices rather materially in one direction or the other. For instance, a seller of comparatively few Brompton and Kensingtons formed sufficient excuse for the price of the Ordinary to be dropped 5s. County of London Ordinary rose as high as 12 bid, business being done in the shares at 12¼—a figure which not unnaturally brought out shares, with the result that the quotation eased off to 11¾, still showing 5s. rise on balance, while the market for the shares is a good one, and there are better buyers than the nominal price would indicate. Metropolitan Preference and Chelsea Ordinary went back ¼, and Charing Cross remain dull. In City's there is nothing much doing, but the Preference receded 10s., which took the price back to 12¾.

A comical little incident occurred in a certain house in the City the other day which is served by the Charing Cross Company and the City of London Company. Owing to some accident, all the lights of those tenants who take their current from one of the

companies went out, and the subscribers to the other were greatly tickled at the sudden demand for candles on the part of their fellow-tenants.

The Railway market lies once more beneath the shadow of strike fears. On the North-Eastern, difficulties have come to an acute point, and certain of the Midland staff are also restless, voicing their grievances in no mild manner. This influence has sufficed to depress prices all round, the Undergrounds not escaping the contagion of general weakness. Metropolitans and Districts, for instance, both lost 1½. Central London fell a point, while City and South London shed 2. The last-named company's four Preference stocks are again each a point to the good, the yields attracting attention from buyers, who found that there was little stock about at the quoted prices.

Considerable publicity has been given during the past few days to the extensive schemes of the London and South-Western for the electrification of part of its suburban system, and this may have something to do with the drop of a point in London United Tramways Debenture. The North-Western, too, is far advanced with its proposals for the conversion of part of its suburban lines to electric traction. It is said that a start is about to be made almost at once.

The prospectus is being advertised this week of the Tramways, Light and Power Company, Ltd., 300,000 6 per cent. Cumulative Preference shares of £1 each being offered at par. The company acquires four undertakings in the Midlands, and although there may be a big future for the concern, investors perhaps might do better with their money elsewhere. The British Electric Transformer Company, too, has been offering 42,286 6 per cent. Cumulative Preference shares of £1 each, also at par. The business of the company consists of the manufacture and supply of electric transformers and electrical apparatus of all kinds for cooking, heating and general domestic purposes, and the new capital should be of substantial use in developing its business.

Foreign tramway issues are quiet, the movements being mostly confined to small fractions. Mexico Trams fell back a trifle, but the Company's 6 per cent. bonds continue in demand, and improvements have taken place in Mexican Electric Lighting bonds and Mexican Light and Power Preferred. Monterey Fives also show a small improvement. On the other hand, Mexican Light and Power Common has given way. Brazilian Tractions fell ¾ on sales from the Continent, where they are held extensively by the speculative investor. Anglo-Argentine Tramways first Preference hardened up to par, but Calcutta Trams lost 5s., and one or two of the British Columbia Electric issues eased off on sales by those who wish to apply for the new issue of stock. River Plate Ordinary shows a loss of 4, and Northern Light and Power bonds slumped 5 on a little pressure to sell. Shawinigan Water more than regained its drop of last week. Victoria Falls Preference went back $\frac{1}{32}$ in sympathy with the dulness of other shares in the Kaffir Circus.

The bears made a drive at National Telephone Deferred stock on the finding of Monday, when the Company agreed to accept two million pounds instead of three millions claimed. From 152 the price dropped to 143, at which there came a recovery to 148, it being argued that too much stress need not be laid on the figures just "quoted." The latest Stock Exchange estimates at the price at which this Deferred stock will be repaid, range from 140 to 170 per cent.; so, manifestly, as we have said again and again, the stock is no purchase for the small investor.

Marconi's, too, gave way sharply when a few of the tired "bulls" began to press their shares for sale. The fall embraced Canadian, Spanish and American Marconi's, and the market for the time being is a dull one. American Telephone and Telegraph descriptions are lower, because of the suggestion raised that in view of the Supreme Court's finding against the Union Pacific Railroad, the Telephone Company may be attacked on a somewhat similar principle. This contention, however, commands little adherence. West India and Panama's drooped to 3½, but the Eastern group is steady, Eastern Ordinary again rising a point. Great Northern Telegraphs went up 10s. Indo-Europeans regained the 10s. lost last week. India Rubber shares have been particularly good, with a rise of 35s. on the declaration of an interim dividend at the rate of 7½ per cent., against nothing a year ago. Of the advance, 10s. was subsequently lost. Telegraph Constructions at 35½ are £1 down.

Manufacturing shares are firm on the Board of Trade figures showing how excellent is the trade of the country. Babcock and Wilcox hardened to 3½, to ease off later to 3⅛ again. Dick, Kerrs are a rather better market, and British Aluminium have improved. Rubber shares have developed unwonted activity, and prices have been going up—in some cases substantially—on the theory that the price of the raw produce will continue its present upward movement.

Bullers, Ltd.—The directors' report for the year ended July 31st last, as abstracted in the *Financial News*, states that the volume of the company's business shows considerable and satisfactory increase; but the trading has been adversely affected by the great rise in the prices of raw materials. The railway and coal strikes also caused heavy losses through stoppage of work and dislocation of business. Several large contracts are on hand, and it is anticipated that the revival of trade will be continued. The accounts show a profit of £11,415, with £583 brought forward. The interest on the preference shares, £7,500, has been paid, leaving £4,498. The directors propose to further strengthen the reserve account by the amount of £4,000, making that account £52,000, and to carry forward £498.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc
Aberdeen	Dec. 4	2,746	+ 23	27	41,933	+ 518	14·4	..
Ayr	„ 7	377	+ 2	29	10,687	+ 268	8	..
†Bath	„ 4	639	— 53	49	43,175	+ 2,264	..	..
Birmingham Corp.	Nov. 30	22,212	+5,652	35	374,901	+112,619	57·17	..
Blackburn	Dec. 4	2,156	+ 148	36	48,533	+ 963	14·62	..
Blackpool Corp.	„ 5	988	+ 78	..	62,684	+ 5,854	11·87	..
Blackpool-Fleetw'd	„ 7	482	+ 2	22	24,521	— 499	8	..
Bournemouth	„ 4	2,836	+ 106	35	68,274	+ 2,098	21·95	..
Bradford	Nov. 30	10,424	+ 591	35	195,591	+ 509	56	..
Brighton	Dec. 8	1,536	+ 32	36	88,463	— 958	9·5	..
Bristol	„ 6	13,106	+1,446	..	339,097	+28,525	30·5	..
Brit. Elec. Trac. Co.								
‡Airdrie	Nov. 29	599	+ 65	48	14,380	+ 3,507	3·65	..
Barnsley	„ 29	201	+ 46	„	8,725	— 169	..	..
Barrow	„ 29	655	+ 96	„	18,180	+ 3,345	5·37	..
Devonport	„ 29	951	+ 35	„	25,691	+ 1,740	8·85	..
Gateshead	„ 29	2,131	+ 67	„	50,246	+ 135	11·25	..
Gravesend	„ 29	416	+ 36	„	10,160	— 98	6·5	..
Greenock	„ 29	1,477	+ 186	„	38,805	+ 3,967	7·25	..
Kidderminster	„ 29	180	+ 6	„	5,705	+ 104	..	..
Merthyr	„ 29	396	+ 8	„	9,678	— 370	2·9	..
Metropolitan	„ 29	16,586	+ 749	„	420,747	— 482	22	..
Middleton	„ 29	585	..	„	16,009	— 327	8·5	..
Mid. Joint Com'tee	„ 29	6,768	+ 612	„	157,506	+ 8,490	..	..
Oldham—Ashton	„ 29	1,154	+ 64	„	29,378	+ 1,687	9·18	..
Peterborough	„ 29	230	+ 19	„	6,552	+ 375	5·81	..
Potteries	„ 29	4,304	+ 192	„	93,086	— 1,179	29	..
Rothesay	„ 29	85	+ 8	„	10,533	+ 500	2·75	..
Southport	„ 29	484	+ 22	„	14,391	— 203	8·17	..
S. Metropolitan	„ 29	1,442	+ 132	„	40,493	— 788	..	..
Swansea	„ 29	2,221	+ 65	„	55,375	+ 340	12·5	..
Tynemouth	„ 29	283	+ 3	„	11,609	— 928	3·75	..
Weston-s-Mare	„ 29	52	+ 3	„	6,812	— 1,296	3	..
‡Worcester	„ 29	505	+ 68	„	14,136	— 64	5·75	..
Wrexham	„ 29	228	+ 22	„	5,535	+ 614	..	..
Yorks. Wool. Dist.	„ 29	2,108	+ 127	„	51,997	+ 1,339	17	..
Miscellaneous	„ 29	413	+ 29	„	11,087	+ 211	..	..
Burnley	Dec. 7	2,869	+ 226	..	..	..	12·44	1
Burton-on-Trent	„ 8	513	+ 6	36	9,829	— 455	6·6	..
Bury	„ 8	2,387	+ 136	36	47,023	— 42	22·5	..
Cardiff	„ 7	4,673	+ 219	36	88,257	— 1,252	17·35	..
Chatham and Dist.	Nov. 28	1,689	+ 136	48	41,105	+ 85	14·98	..
Cork	Dec. 5	664	— 3	49	23,491	— 942	9·89	..
Croydon	Nov. 29	3,291	+ 310	..	68,536	— 512	11·6	..
†Darlington	„ 30	226	+ 20	35	7,908	— 1,106	4·87	..
Darwen	Dec. 6	514	+ 27	36	10,093	+ 332	4·36	..
Dover	Nov. 30	378	+ 20	35	8,890	— 576	4·75	..
Dublin	Dec. 6	10,566	— 10	..	132,627	— 8,135	54·25	..
East Ham	„ 7	2,043	— 45	36	38,721	— 860	7·87	..
Glasgow	„ 7	36,974	— 906	..	510,636	—10,000	98	..
Hastings	„ 5	1,268	— 3	..	..	— 2,399	19·3	..
Hull	„ 7	6,029	+ 170	36	106,924	+ 1,471	13·5	—1
†Ilkeston	„ 5	109	— 11	36	4,060	— 751	..	..
Ipswich	„ 7	701	+ 88	36	16,865	— 110	10·5	..
†Kilmarnock	Nov. 30	147	— 8	28	4,657	— 164	4·25	..
Lancashire United	Dec. 4	2,544	+ 81	49	65,957	+ 190	39	..
Leeds	„ 7	14,931	+ 542	36	281,485	+ 9,689	65	7·5
Leicester	„ 7	5,275	+ 347	49	125,369	+ 4,295	20	..
†Leith	Nov. 30	600	+ 17	28§	19,595	+ 524	8·72	..
Liverpool	„ 30	23,842	+1,703	47§	574,123	+25,249	119	3
‡L.C.C.	Dec. 6	81,389	—1,758	..	1,452,786	—74,665	141·5	—1·25
London United	„ 7	10,586	— 80	..	304,167	—13,540	..	..
Lowestoft	„ 7	317	+ 15	9	1,714	— 3	3·5	..
Manchester	„ 7	32,823	+1,288	36	605,729	+21,464	105	..
Newcastle	„ 7	8,928	+ 316	..	159,283	+ 3,485	31·3	..
Newport	Nov. 20	1,379	+ 84	35	24 807	— 320	7·25	..
Oldham	Dec. 8	3,792	+ 113	37	76,085	+ 4,617	23	..
Pontypridd	Nov. 30	828	+ 44	35	13,997	— 600	5·5	..
Preston	..	..	..	..	..	..	10	..
Rotherham	Dec. 4	1,678	+ 355	35§	27,465	+ 3,023	18	6
Salford	„ 9	9 639	+ 250	36½	182,204	+ 4,890	41	..
Sheffield	„ 10	13,901	+ 904	..	248,199	+11,181	40	..
Southampton	„ 4	2,188	— 3	35	44,808	— 197	11	..
Southend-on-Sea	„ 4	1,062	+ 189	36	29.622	+ 3,186	7	..
South Shields	„ 7	1.152	+ 9	36	22,999	+ 266	10·25	..
Tyneside	„ 4	861	+ 7	23	11,201	— 579	11	..
Wallasey	„ 7	1,955	+ 3	35§	40,430	— 243	8·72	..
Walthamstow	„ 7	1,269	+ 35	36	26,363	— 1,117	9	..
West Ham	Nov. 28	4.993	— 151	34½	91,155	— 3,693	16·45	1·2
Wolverhampton	..	..	..	..	..	..	13·75	..
Cen. London Rly.	Dec. 7	11,513	+ 774	23	112,890	+ 3,776	6·78	·5
City & S. Lon. Rly.	„ 8	5,165	— 842	23	67,492	— 5,958	7·26	..
Dublin-Lucan Rly.	..	..	..	..	..	..	7	..
G.N. and City Rly.	„ 7	3,000	— 424	23	32,459	— 874	3·5	..
L'pool Overh'd Rly.	„ 8	3,132	+ 290	..	37,657	+ 3,174	6·6	..
Llandudno-Col. Bay	„ 6	261	+ 23	..	..	..	6·6	..
Lond. Elec. Ry. Co.	„ 7	29,465	+ 5	..	301,315	+ 4,520	21·26	..
Mersey Railway	„ 7	4 633	+ 302	23	49,506	+ 4,866	4·5	..
Metropolitan Rly.	„ 8	96,485	— 149	23	392,015	+ 5,270	25·76	..
Met. District Rly.	„ 7	26,520	+1,848	..	287,779	+ 22.978	25	..
Anglo-Argentine	„ 2	109,929	+5,197	..	2,470,288	+116,632	..	..
§Auckland	Nov.	19.174	+ 2,580	..	97.203	+15,752	24·11	·8
Bombay (B.E.T.)	Nov. 8	6.266	— 310	45	135 526	+ 6,055	..	..
§Brisbane	Nov.	24,310	+ 2,420	11	228,421	— 551	..	..
Calcutta	Dec. 7	8 823	+1,103	..	..	..	..	..
§Kalgoorlie, W.A.	Oct.	2,955	..	..	31.743	..	20·5	..
Madras	Nov. 30	1 460	+ 83	..	36,326	+ 3,775	14·7	2
§Montevideo	Nov.	19 623	+3 009	..	..	..	..	..
Perth (W.A.)	Dec. 6	3.183	+ 139	..	91,807	+ 12,987	29	..

* Compared with the corresponding period of 1911. † One week only.
‡ Includes horse, steam and other receipts. § One month.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended September 27th, 1912, amounted to 1,258,799 compared with 1,032,358 units in the corresponding four weeks of 1911. For the five weeks ended November 1st, 1912, the units delivered amounted to 1,386,195, compared with 1,116,408 in the corresponding five weeks of 1911.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 10th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord. ..	10	5⅞	6†	9⅛ — 10⅛	..	5 4 9
Do. 4½ % Pref.	10	4½	4½	8⅞ — 9⅜	..	4 12 4
Do. Second 6 % Pref. ..	10	6	6	10 — 10⅝	..	5 14 8
Do. 4½ % Deb. Stock	Stock	4½	4½	98 —100	..	4 10 0
Brompton & Kensington, Ord...	5	10	9†	8⅞ — 9⅛	— ⅛	5 8 1
Do. 7 % Cum. Pref.	5	7	7	8½ — 9	..	3 17 9
Central Electric Supply, 4 % Guar. Deb.	100	4	4	95 — 98 xd	..	4 1 8
Charing Cross, West End & City	5	5	5†	4⅞ — 5⅛	..	4 15 3
Do. 4½ % Cum. Pref.	5	4½	4½	4⅞ — 4⅞	..	4 14 9
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	4 — 4½	..	5 0 0
Do. Do. 4 % Deb... ..	100	4	4	94 — 96	..	4 8 4
Chelsea, Ord.	5	5	4†	4½ — 5	— ⅛	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	98 —101	..	4 9 1
City of London, Ord.	10	8	6†	16 — 18	..	4 9 0
Do. 6 % Cum. Pref.	10	6	6	12 — 13⅛	— ⅛	4 9 0
Do. 5 % Deb.	Stock	5	5	118 —122	..	4 2 0
Do. 4½ % Second Deb. ..	100	4½	4½	100 —109	..	4 7 5
County of London, Ord... ..	10	6	4†	11½ — 12	+ ¼	5 0 0
Do. 6 % Pref.	10	6	6	11⅜ — 12⅛	..	4 19 0
Do. 4½ % Deb.	Stock	4½	4½	106 —108	..	4 3 4
Do. 4½ % Second Deb. ..	Stock	4½	4½	98 —101	..	4 8 3
Edmundson's, Ord.	5	Nil	..	⅜ — ⅝	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	3 — 3½	..	Nil
Do. 4½ % First Mort. Deb. ..	100	4½	4½	84 — 87	..	5 3 6
Folkestone	5	6	6	4⅝ — 5⅛	..	5 17 1
Do. 5 % Cum. Pref.	5	5	5	4⅝ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	92 — 95	..	4 14 9
Hove	5	9	8†	7⅞ — 8	..	5 12 6
Kensington & Knightsbridge, Ord	5	9	8†	7⅞ — 8⅛	..	5 10 9
Do. 4 % Deb.	Stock	4	4	90 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb. ..	Stock	4½	4½	78 — 82	..	5 9 9
London Electric, Ord.	8	2½	..	1¼ — 2	..	3 15 0
Do. 6 % Pref.	5	6	6	4⅝ — 5½	..	5 14 8
Do. 4 % First Mort. Deb. ..	Stock	4	4	90 — 93	..	4 6 0
Metropolitan	5	4	4†	3⅜ — 3⅝	..	5 3 3
Do. 4½ % Cum. Pref.	5	4½	4½	4⅛ — 4⅜	— ⅛	5 0 0
Do. 4½ % First Mort. Deb. ..	Stock	4½	4½	99 —102	..	4 8 3
Do. 3½ % Mort. Deb.	Stock	3½	3½	86 — 88	..	3 19 7
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	99 - 101	..	4 9 1
Newcastle-on-Tyne 5 % Pref., Non-Cum.	5	5	5	4⅜ — 4⅞	..	5 2 7
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	98½ —101½	..	4 18 6
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	10 — 11	..	5 9 1
Oxford	5	7½	6†	6¼ — 6⅝	..	5 9 6
St. James' and Pall Mall, Ord.	5	10	10†	9¼ — 10½	..	4 17 7
Do. 7 % Pref.	5	7	7	6⅝ — 7½	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	85 — 88	..	3 19 7
Smithfield Markets, Ord. ..	5	2	..	1⅜ — 1⅞	..	..
South London, Ord.	4	5	..	2⅝ — 3⅜	..	5 18 4
Do. 5 % First Mort. Deb. ..	100	5	5	98 —101	..	4 19 0
South Metropolitan, 7 % Pref...	1	7	7	1⅝ — 1⅞	..	5 9 5
Do. 4½ % First Deb. Stock ..	100	4½	4½	96 — 99	..	4 11 3
Urban, Ord...	£3	Nil	..	¼ — ⅜	..	..
Do. 5 % Cum. Pref.	5	2	†	2⅜ — 3⅜	..	..
Do. 4½ % First Mort. Deb. ..	100	4½	4½	84½ — 88½	..	5 1 8
Westminster, Ord.	5	10	9†	8⅜ — 9¼	..	5 8 1
Do. 4½ % Cum. Pref.	5	4½	4½	4⅞ — 5¼	..	4 5 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅞ — 5⅝	..	5 6 8
Calcutta, Ord.	5	8½	7†	6⅝ — 7⅜	..	5 19 4
Do. 5 % Pref.	5	5	5	4 11/16 — 5 1/16	..	4 16 5
Calgary Power, 1st Mort. Bds.	100	5	5	94 — 96	..	5 4 2
Canadian Gen. El. Com. ..	$100	7	7	118 —122	..	5 14 8
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	8	..	⅞ — 1	..	8 0 0
Do. 5 % Deb.	100	5	5	95 — 98	..	5 2 0
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	95 — 97	..	6 3 9
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	86 — 89	+1	5 12 4
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	95½ — 97½	..	5 2 7
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	1/16 — 1/8	..	Nil
Do. 6 % Pref.	1	6	6	1/16 — 1/8	..	8 14 6
Kaministiquia Power, 5 % G. Bs.	$500	5	5	104 —106	..	4 14 4
Madras, Ord.	5	Nil	..	1⅛ — 2	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	102 —105	..	4 15 8
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	86½ — 88½	+ ½	5 18 0
Mexican Lt. & Power, Common	$100	4	4†	83½ — 86½	—1	4 12 6
Do. 7 % Cum. Pref.	$100	7	7	104 —107	+1	6 10 10
Do. 5 % 1st Mort. Gold Bds.	..	5	5	95 — 97	..	5 3 1
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	85½ — 87½	+1	5 14
Montreal, Lt., H. and Power ..	$100	8	9†	234 —239	..	3 15
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5a	29 — 33	—5	..
River Plate, Ord.	Stock	10	..	248 —244	—4	4 2 0
Do. 6 % Non-Cum. Pref. ..	Do.	6	6	106 —111	..	5 6 3
Do. 5 % Deb. Stock	Do.	5	5	102 —104	..	4 16 2
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	98 —100	..	4 10 0
Shawinigan Water, Capital ..	$100	5	5	141 —145	+4	3 9 0
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	106 —108	..	4 12 9
Do. 4½ % Per. Deb.	Stock	4½	4½	100 —102	— ½	4 8 3
Toronto Power, 4½ % Deb. ..	Do.	4½	4½	99½ —101½	..	4 7 5
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	93½ — 96½	..	5 3 8
Victoria Falls Power, Pref. ..	1	117d.	17/6d.	32/32 — 31/32	— 1/32	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	103½ —105½	..	5 13 9

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	4	4½†	7⅞ — 7⅞	..	5 14 3
Do. 5 % Deb. Red.	Stock	5	5	97 — 99	..	5 1 0
American Telep. & Teleg., Cap.	$100	8	8†	142½ —144½	—2½	5 10 9
Do. Collat. Trust	$1000	4	4	93 — 95	— ½	4 4 3
Anglo-American Telegraph ..	Stock	8	8	67 — 69	..	4 7 0
Do. 6 % Pref.	Do.	6	6	110¼ —111½	..	5 7 8
Do. Def.	Do.	80/-	..	25½ — 26	..	5 15 5
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	5	7	8	7⅛ — 7⅞	..	5 3 3
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	80¾ — 82½	..	4 17 0
Cuba Telegraph	10	6	6†	8½ — 9⅛	..	6 6 4
Do. 10 % Pref.	10	10	10	16 — 17	..	5 17 8
Direct Spanish Telegraph, Ord.	5	4	4†	3⅞ — 4	..	5 0 0
Do. 10 % Cum. Pref.	5	10	10	6⅞ — 7	..	7 2 10
Direct United States Cable ..	10	5	4	7 — 7⅛	..	6 13 4
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98½ —100½	..	4 9 7
Eastern Telegraph, Ord. Stock	Stock	7	7†	133 —136	+1	5 3 0
Do. 8½ % Pref. Stock.. ..	Do.	8½	8½	77 — 79	..	4 8 7
Do. 4 % Mort. Deb.	Do.	4	4	95⅛ — 97½	..	4 2 1
Eastern Extension	10	7	7†	13 — 13½	..	5 3 8
Do. 4 % Deb.	Stock	4	4	96 — 98	..	4 1 8
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	98 — 101	..	3 19 8
Globe Telegraph and Trust ..	10	6	6†	10⅞ — 11½	..	5 7 7
Do. 6 % Pref.	10	6	6	12⅛ — 13	— ⅛	4 12 4
Great Northern Telegraph ..	10	18	18	29 — 30	+ ½	6 0 0
Indo-European Telegraph ..	25	18	5†	56 — 58	+ ½	5 12 1
Mackay Companies Common ..	$100	5	5†	86 — 89	..	5 14 4
Do. 4 % Cum. Pref.	$100	4	4	69 — 73	..	5 9 7
Marconi's Wireless Telegraph	1	20	..	4⅜ — 4⅝	— 1/16	8 17 2
Do. 7 % Cum. Partic. Pref.	1	17	..	4⅛ — 4⅜	— ¼	8 13 7
Monte Video Telephone, Ord...	1	6	6†	15/16 — 1 1/16	..	5 13 0
Do. 5 % Pref.	1	5	5	29/32 — 31/32	— 1/32	5 18 6
National Telephone Def. ..	Stock	6	..	145 —148	—9	..
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	97⅞ — 98⅜	— ⅛	4 11 2
Oriental Telep. and Elec. ..	1	8	6†	13⅞ — 14⅜	..	4 9 10
Do. 6 % Cum. Pref.	1	6	6	1 3/32 — 1 5/32	+ 1/32	4 18 6
Do. 4 % Red. Deb.	Stock	4	4	88 — 90	..	4 9 0
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 —100	..	4 0 0
Reuter's	10	10	10†	10⅞ — 11⅜	..	8 16 2
Submarine Cables Trust ..	Cert.	6	6	127 —130	+1	4 12 4
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99½ —101½	..	4 8 8
United River Plate Telephone	5	8	..	7⅜ — 7⅝	+ 1/16	5 5 10
Do. 5 % Cum. Pref.	5	5	5	5⅜ — 5⅝	..	4 8 11
West Coast of America	2½	2½	..	1 13/32 — 1 15/32	..	8 18 5
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	96 — 99	..	4 0 10
West India and Panama Teleg.	10	2½	1½†	3⅛ — 3⅜	— 1/16	..
Do. 6 % Cum. 1st Pref. ..	10	6	6	10 — 10½	..	5 14 8
Do. 6 % Cum. 2nd Pref. ..	10	6	6	9½ — 10	..	6 0 0
Do. 5 % Debs.	100	5	5	101⅛ —103½	..	4 16 7
Western Telegraph, Ltd. ..	10	7	7†	13⅛ — 13⅝	..	5 1 10
Do. 4 % Deb.	Stock	4	4	95/8 — 97½	..	4 2 1
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	98 —101	..	4 9 1

* Unless otherwise stated, all shares are fully paid. a Paid in deferred interest warrants. † Interim Dividend. ‡ 3s. in Funded Dividend Certs

CONTINUED ON NEXT PAGE.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 10th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	* 1	Nil	Nil	⅜ — ⅝	..	Nil
Do. 5 % Pref.	1	5	5	1/16 — 1/8	..	6 8 1
Do. 4½ % Deb.	100	4½	4½	76 — 81	..	5 11 1
Brit. Elec. Trac., 5 % Pref.	100	..	..	11⅛ — 13⅛	..	..
Do. Do. Deferred	100	..	..	5 — 7	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	90 — 93	..	6 9 0
Do. 7 % Non-Cum. Pr'f.	100	..	..	39 — 42	+1	..
Do. 5 % Perp. Deb.	100	5	5	90 — 93	−2½	5 7 6
Do. 4½ % 2nd Deb.	100	4½	4½	77 — 81	..	5 7 2
Central London Railway, Ord.	100	8	8†	81 — 83	+1	3 12 3
Do. Pref.	100	4	4	81 — 88	..	4 16 5
Do. Def.	100	2	..	80 — 82	..	2 8 9
Do. 4 % Deb.	100	4	4	100 —102	..	3 18 5
City & South London, Ord.	100	1⅜	1⅛†	35⅛ — 36⅛	−2	3 15 4
Do. 5 % Pref., 1891	100	5	5	109 —111	+1	4 10 1
Do. Do. 1896	100	5	5	109 —111	+1	4 10 1
Do. Do. 1901	100	5	5	109 —111	+1	4 10 1
Do. Do. 1908	100	5	5	109 —111	+1	4 10 1
Do. 4 % Deb.	100	4	4	98 —100	..	4 0 0
Dublin United Trams, 6 % Pref.	10	6	6	12 — 13	..	4 12 4
Great Northern & City, Pr'f. Ord	10	Nil	Nil	2⅛ — 2⅜	..	Nil
Hastings Trams, 6 % Pref.	1	6	6†	4⅛ — 4⅜	..	8 6 8
Do. 4½ % Deb.	100	4½	4½	69 — 74	..	6 1 7
Isle of Thanet Trams, 5 % Pref.	5	2½	..	2⅛ — 2⅜	..	4 11 0
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	81 — 83	..	6 0 6
London Elec. Railw'ys, 4 % Deb.	100	4	4	96 — 98	..	4 1 8
London United Trams, 5 % Pref.	10	Nil	..	5⅛ — 5⅜	..	..
Do. 4 % Deb.	100	4	4	73 — 76	−1	5 5 3

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 10th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Metropolitan Railway Consol.	* 100	1⅞	1½†	54½ — 54¾	−1½	2 19 4
Do. Surplus Lands	100	2⅛	2⅛†	62 — 64	..	4 6 0
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 16 11
Do. 3½ % Pref.	100	3½	3½	85 — 87	−1	4 0 6
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	Nil	40⅜ — 41½	−1½	Nil
Do. 6 % Deb.	100	6	6	141 —143	..	4 4 0
Do. 4 % Deb.	100	4	4	94 — 96	..	4 3 4
Do. 4 % Prior Lien	100	4	4	99 —101	+1	3 19 8
Do. 4½ % First Pref.	100	4½	4½	88 — 90	..	5 0 0
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 9
Metropolitan Elec. Trams, Ord.	1	5	5†	1⅛ — 1⅜	..	4 16
Do. Def.	1	Nil	..	1/16 — ⅛	..	Nil
Do. 6 % Pref.	1	5	5	⅛ — 3/16	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	93 — 95	..	4 14 9
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Potteries, Ord.	1	3½	..	3/16 — 7/32	..	..
Do. 5 % Pref.	1	5	5	7/32 — ¼	..	6 19 0
Do. 4½ % Deb.	100	4½	4½	85 — 88	..	5 2 8
South Metro. Trams, 6 % Pref.	1	6	..	1/16 — 1/8	..	7 7 8
Do. 4 % Deb.	100	4	4	67 — 72	..	5 11 1
Underground Elec. Railways	10	..	..	4⅛ — 4⅜	— ¼	Nil
Do. "A"	1/-	..	..	3/16 — 7/32	..	..
Do. 6% First Cum. Inc. Deb.	100	..	6	112 —114	..	5 5 3
Do. 4½ % Bonds	100	4½	4½	100 —102	..	4 8 3
Do. 6 % Income	100	1½	£2	90 — 92	−1	..
Yorkshire (West Riding), Ord.	5	Nil	..	1/16 — 3/16	..	Nil
Do. 6 % Pref.	5	3	..	3 — 3½	..	4 5
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	5½	4⅞ — 5⅛	+ 1/16	4 17 9
Do. 2nd Pref.	5	5½	5½	4¹¹/₁₆ — 4¹³/₁₆	..	5 17 4
Do. 4 % Deb.	100	4	4	93 — 95	..	4 4 8
Do. 4½ % Deb.	100	4½	4½	99 —101	..	4 9 1
Do. 5 % Deb.	100	5	5	97⅛ — 99⅛ xd	+ ⅛	5 0 6
Auckland Trams, 5 % Deb.	100	5	5	103⅛—105⅛	..	4 14 9
Bombay Elec. S. & Trams, Pref.	10	6	6	11 — 12	..	5 0 0
Do. 4½ % Deb.	100	4½	4½	98 —100	..	4 10 0
Do. 5 % 2nd Deb.	100	5	5	99 —101	+1	4 19 0
Brazilian Traction Light and Power	$100	..	..	93⅜—94⅜	— ⅜	..
Brisbane Trams Invt., Ord.	5	8	8†	7⅛ — 7⅝	..	5 9 5
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	100⅜—103⅜	..	4 7 0
B. Columbia Elec. Rly., Def.	100	8	..	143 —148	−1	5 8 1
Do. Pref. Ord.	100	6	6	116⅜—120⅜	−1½	4 19 7
Do. 5 % Pref.	100	5	5	105⅜—109⅜	− ⅜	4 11 4
Do. 4½ % 1st Mort. Deb.	40	4½	4½	98 —101	..	4 9 1
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	100 —103	..	4 2 6
Calcutta Trams, Ord.	5	7	5†	5⅜ — 6⅛	— ⅛	5 14 3
Do. 5 % Pref.	5	5	5	4¹⁵/₁₆ — 5⅛	..	4 16 5
Do. 4½ % Deb.	100	4½	4½	99 —102	..	4 8 3
Cape Electric Trams	1	2½	..	2⅜ — 2⅝	..	..
City Buenos Aires Trams (1904)	5	5	5†	5⅛ — 5⅜	..	4 8 0
Do. 4 % Deb.	100	5	5	99 —102	..	4 18 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 97	..	5 2 1
Havana Elec. Rly., 5 % Bonds	$1000	5	5	99 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	⅝ — ¾	..	Nil
Do. 5 % A Deb.	100	5	5	86 — 91	..	5 10 0
Do. 6 % B Deb.	100	6	3	35 — 43	..	..

La Plata Elec. Trms, Ord.	1	Nil	..	⅛ — ¼	..	..
Do. Pref.	1	6	..	¾ — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	6	6†	1 — 1⅛	..	4 16 0
Do. 6 % Pref.	1	6	6	1 — 1⅛	..	4 16 0
Do. 5 % Deb.	100	5	5	93 — 97	..	5 3 1
Madras Elec. Tr. (1904), Deb.	100	5	5	100 —102	..	4 18 0
Manaos Trams & Lt., 1st Deb.	100	5	5	89 — 92	..	5 8 8
Manila Elec. R. and Ltg., Bonds	$1000	5	5	100½—102½	..	4 17 7
Mexico Trams Com.	$100	7	7†	112 —114	−2½	6 2 10
Do. Gen. Con. 5 % Bonds	..	5	5	95½ — 97½	..	5 2 7
Do. 6 % Bonds	100	6	6	101½—103½	+ ½	5 16 0
Para Elec. Rlys. & Lt., Ord.	5	10	10†	7¼ — 7⅝	+ ⅛	6 9 0
Do. 6 % Pref.	5	6	6	5 — 5½	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	96½ — 98½	..	5 1 6
Perth (W.A.) Elec. Tr., Ord.	1	5	5½	1⅝ — 1¾ xd	..	3 14 5
Do. 5 % 1st. Deb.	100	5	5	99 —102	..	4 18 0
Rangoon El. Tr. & Sup., Pref.	5	6	6	5½ — 6	..	5 0 0
Do. 4½ % 1st Deb.	100	4½	4½	99 —101	..	4 9 1
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	102 —104	+ ½	4 16 2
Do. 5 % Mort. Bonds	100	5	5	97 — 99	..	5 1 0
Sao Paulo Tram, Lt. and P. 5 % 1st Deb.	$500	5	5	101½—103½ xd	−½	4 16 7
Singapore Trams, 5 % Deb.	100	5	5	82 — 85	..	5 17 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	96 — 98	..	5 2 0
Un. Elec. Trams Monte Video	5	7	..	5⅝ — 6⅛	..	5 14 3
Do. 6 % Pref.	5	6	..	5 — 5½	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	99 —102	..	4 18 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	100 —103	..	4 7 5

MANUFACTURING COMPANIES.

Aron, Ord.	1	6	..	⅜ — ½	..	8 0 0
Do. 6 % Pref.	1	6	6	11/16 — ¾	..	7 7 8
Babcock & Wilcox	1	28	14†	3 — 3⅛	..	4 6 2
Do. Pref.	1	6	6	1⅞ — 1¹⁵/₁₆	..	3 46 10
British Aluminium, Ord.	1	Nil	..	⅞ — 1	+ 1/16	..
Do. 6 % Cum. Pref.	1	Nil	..	11/16 — ¾	..	..
Do. 5 % Prior Lien Debs.	100	5	5	92 — 95	..	5 5 2
Do. Deb. Stk.	100	5	5	86 — 89	..	5 12 4
B.I. & Holsby Cables	5	10	8†	7⅜ — 8	..	6 5 0
Do. Pref.	5	8	6	5⅞ — 6⅛	..	4 14 1
Do. Deb.	100	4½	4½	103 —105	..	4 5 9
British Thomson-Houston, Deb.	100	4½	4½	94 — 96	..	4 13 9
British Westinghouse, Pref.	8	Nil	Nil	½ — ¾	..	Nil
Do. Deb.	100	4	4	58 — 61	−1	6 11 2
Do. 6 % Prior Lien	100	6	6	100 —103	..	5 16 6
Browett, Lindley, Ord.	1	..	..	2/- —3/-	..	Nil
Do. Pref.	1	..	..	4/6 —6/-	..	Nil
Brush, 7 % Pref.	2	Nil	Nil	0 — ¼	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	75 — 80	..	6 5 0
Do. 4½ % Deb.	100	4½	4½	47 — 52	..	8 13 2
Do. 4½ % Second Deb.	100	4½	4½	30 — 34	..	13 4 8
Callender's Cable	5	15	10†	10⅜ — 11½	..	6 13 4
Do. Pref.	5	5	5	4⅞ — 5⅛	..	4 17 7
Do. Deb.	100	4½	4½	99½—101½	..	4 8 8
Castner-Kellner	1	20	20	31⅛ — 31⅝ xd	..	5 4 11
Do. Deb.	100	4½	4½	105 —108	..	4 3 4

Crompton & Co.	8	Nil	..	⅛ — ⅜	..	Nil
Do. Deb.	100	5	5	56 — 66	..	7 11 6
Dick, Kerr	1	5	Nil	2 — 2⅛	..	..
Do. Pref.	1	6	6	3⅛ — 3⅜	— 1/16	6 17 2
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Edison & Swan, A, £8 paid	5	Nil	..	⅛ — ¼	..	Nil
Do. fully paid	5	Nil	..	1¾ — 2	..	Nil
Do. 4 % Deb.	100	4	4	65 — 69	..	5 16 0
Do. 5 % Second Deb.	100	5	5	72 — 75	..	6 18 4
Electric Construction	2	2½	3⅛	1⅝ — 1¹³/₁₆	..	7 1 4
Do. Pref.	2	7	7	1¹⁵/₁₆ — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7⅞ — 8	..	8 6 8
Do. Deb.	100	5	5	92 — 94	..	5 4 2
General Electric, Pref.	10	5	5	10 — 11	..	..
Do. Deb.	100	4	4	90 — 95	..	4 4 3
Henley's, Ord.	5	17	5†	12¾ — 13	..	6 10 9
Do. Pref.	5	4½	4½	4⅞ — 5⅛	..	4 9 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
India-Rubber, G. & T.	10	..	7½	10⅞ — 11⅛	+1⅛	..
Do. Pref.	10	5	5	9¾ — 10⅛	..	4 17 7
Telegraph Construction	12	17½	6†	84½ — 86½	−1	5 13 0
Do. Deb.	100	4	4	97 —100	..	4 0 0
Willans & Robinson	1	Nil	..	1/16 — ⅛	..	Nil
Do. Pref.	5	Nil	..	¼ — ⅜	..	Nil
Do. Deb.	100	4	4	57 — 59 xd	..	6 15 7

* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Bank rate of Discount 5 per cent., October 17th, 1912.

INDUSTRIES AND INDUSTRIAL CONDITIONS IN THE ARGENTINE.

By ALFRED H. GIBBINGS, A.M.I.C.E., of Buenos Ayres

The subject of these articles is one on which there is remarkable dearth of information. With the exception of the Argentine Government's statistics—more or less buried in oblivion—there is no treatise or publication which makes more than the briefest reference to any industry other than that of agriculture and cattle-rearing. Hence the Argentine has been looked upon as a non-manufacturing country in which the exports of wheat, grain, frozen meat, hides, and certain natural products are set against the imports of manufactured goods. In terms of percentage imports to home manufactures, this view is, of course, very largely the correct one, but on closer acquaintance with the country, it becomes evident that the industrial side is already firmly established, and, moreover, that it is making rapid headway.

It is the intention in this article to give a general indication of the position, gathered from residence in the country, and the exigencies of a business which necessitated the compilation of considerable data. By way of preliminary and explanation, it may be stated that neither the Government nor the Municipalities concern themselves with the publication of any other than statistical information necessary for the purposes of taxation and incidental thereto. The only serious attempt at classification and location is contained in the "Guia Kraft," a voluminous directory dealing with the whole of the provinces and territories, and modelled on the lines of the Post Office London Directory. The information given, however, is merely a record of names and addresses, with no attempt at grouping, or indication of the importance of, the respective concerns. The official books issued by the Government are purely statistical, there being nothing to correspond to our Factory and Workshop Acts, Inspection of Factories, or Inspection of Mines. To add to these difficulties, there is the immense area of the country, and the characteristic indifference of the Spanish race to do more than the immediate occasion requires.

In the coming year (1913) some attempt will be made to remedy this state of things by the Union Industrial Argentina, an immense trade organisation whose headquarters are in Buenos Ayres, and to which further reference will be made when dealing with the industrial conditions. Before proceeding with the enumeration of industries, it will be advisable to consider the position as regards the general demand for goods.

Demand for Goods.—It is assumed herein that the characteristics of the country are well known as regards its main sources of wealth, its climate, minerals, productions, geography, inhabitants, and its laws and customs. On this account it is not proposed to deal with the agricultural and cattle-rearing industry, as that is the staple industry on which many voluminous treatises have already been written; but the other industrial features arising directly out of it will be considered, as far as space will admit.

The most startling fact of this most extraordinarily prosperous country is that the annual exports (amounting to over £80,000,000 in 1909) exceed the imports by £20,000,000, or, in other words, the money coming into the country annually is over 30 per cent. more than that going out. Hence, notwithstanding the extremely high prices for everything which rule here, there is ample money available for the development of business and for luxurious living. These two factors, therefore, mean a constant demand for goods of every description, and usually for goods of the highest quality and class.

It would be difficult to find anywhere a more active and busy city than Buenos Ayres. It has an area of 70 sq. miles and a population of 1,500,000, and within an area of 1 sq. miles in the centre, the traffic and business life are equal to the busiest parts of the city area of London. From this and other causes arises a great demand for both office and living accommodation, and consequently the value of property stands at a very high figure. The average rental is about £6 per superficial yard per annum, or twice that obtained in the City of London. This prosperous state of trade clearly indicates that the demand is greater than the supply, and this again is due very largely to the following factors:—(*a*) No local production of manufactured articles; (*b*) inability to obtain goods delivered to the port owing to congestion of shipping: (*c*) increase in population—through immigration—being greater annually than increase of imports; and (*d*) duties on all imported articles.

The quality of all goods has to be of the best, with articles for domestic use highly finished and ornate. No better tailoring or dressing is to be found either in London or Paris. The natural inference from all this is that every country in the industrial world caters for this market. The proportion of such imports among the more important countries for the the three years ending 1909 is shown in the following Table I:—

TABLE I.—Total Imports into the Argentine.

	1907.	1908.	1909.
Great Britain ...	£19,587,000	£18,674,000	£19,840,000
Germany	9,162,000	7,569,000	8,911,000
U.S.A.	7,768,000	7,119,000	8,613,000
France	5,093,000	5,295,000	6,160,000
Italy	4,800,000	4 983,000	5,373,000
Belgium	3,181,000	2,550,000	2,714,000
Other Countries ...	7,571,000	8,400,000	9,740,000
Grand Total ...	£57,162,000	£54,590,000	£61,351,000

Works and Factories.—Notwithstanding the foregoing immense importation of manufactured goods, there is a considerable number of works and factories as shown by the figures in Tables II and III.

TABLE II.—Works and Factories Classified According to the Numbers of Operatives Employed.

	No of works.	No. of operatives employed.	H.P. installed.
Manufacture of wine ...	3,409	45,776	6,258
Sugar mills	37	38,591	34,650
Boot factories	2,217	13,154	943
Brick works	1,281	11,150	379
Carpenters' shops	2,814	9,324	2,806
Smithies	2,932	8,735	1,569
Saw mills	283	8,081	7,641
Printers	739	6,763	1,757
Cold storage plants... ...	8	5,817	12,424
Carriage and cart works ...	876	5,229	1,427
Tobacco factories	171	4,525	654
Mechanics' shops	335	4,399	2,773
Flour mills	330	4,309	16,348
Leather dealers	747	3,579	128
Foundries	98	3,415	1,853
Tanneries	227	3,389	4,014
Breweries	24	3,049	2,206
Wool factories	33	3,006	1,993
Confectionery works ...	230	2,998	926
Canvas shoe factories ...	170	2,986	793
Lithograph works	39	2,833	576
Agricultural implements ...	88	2,642	1,935
Meat preserving factories ...	6	2,535	1,404
Electricity works	56	2,402	80,826
Cloth weavers	47	2,390	798
Match factories	10	2,313	239
Vermicelli works	272	2,301	2,379
Sack works	20	2,272	464
Lime works	116	2,249	917
Distilleries	263	2,233	465
Gas works	12	2,208	1,697
Mineral water works ...	560	2,195	890
Mosaic works	149	1,559	281
Ship repairers	23	1,504	407
Cotton mills	5	1,415	800
Paper mills	12	1,405	4,733
Copper mines	5	1,269	1,165
Sugar refineries	1	1,000	1,600
Marble works	215	965	247
Soap factories	200	942	215
Dyers and cleaners	82	872	442
Electric and gas fittings ...	41	759	244
Ice factories	56	593	2,580
Galvanised iron works ...	1	520	200
Other works (small) ...	12,748	99,838	21,614
Totals	31,988	329,490	229,660

The total capital invested in the foregoing industries is over £146,000,000.

These tables are compiled from the "Censo Industrial de la República" issued by the Ministerio de Agricultura of the Argentine Government. They are representative of the position at the end of 1909, since when no further census has been taken. In nearly every instance, however, great increases have taken place, and an indication of the progress

TABLE III.—Works and Factories Classified According to Location in the Several Provinces and Territories.

Provinces and territories.	No. of factories.	Motive power.							No. of employés.
		Horses.	Hydraulic.	Oil.	Gas.	Electricity.	Steam.	Total H.P.	
Federal capital (Buenos Ayres) ...	10,427	—	—	476	1,939	12,505	90,655	105,575	118,435
On the Coast.									
Buenos Ayres (Province of)	8,988	427	783	862	1,147	3,235	35,089	41,543	48,775
Santa Fé ,, ...	2,986	96	415	483	526	2,666	9,701	13,887	21,866
Entre Rios ,, ...	1,513	124	36	149	192	155	3,621	4,277	14,785
Corrientes ,, ...	632	48	—	35	2	26	1,719	1,830	3,429
Central.									
Cordoba (Province of)	1,310	47	5,266	116	43	1,701	3,010	10,183	11,708
San Luis ,, ...	251	14	—	24	—	—	110	148	948
Santiago del Estero (Province of) ...	280	15	—	4	16	—	1,769	1,804	11,267
Andes.									
Mendoza (Province of)	1,950	97	1,753	1,261	411	894	2,706	7,122	26,864
San Juan ,, ...	673	1	366	158	90	33	1,441	2,089	7,765
La Rioja ,, ...	577	3	721	—	—	—	48	772	4,560
Catamarca ,, ...	418	37	35	—	—	—	287	359	3,848
North.									
Tucumán (Province of)	652	16	50	43	—	283	32,345	32,737	33,240
Salta ,, ...	369	5	126	66	—	—	1,046	1,243	5,859
Jujuy ,, ...	194	2	43	4	—	9	2,437	2,495	9,145
Territories.									
Misiones	199	4	85	1	—	—	148	238	1,119
Formosa	43	4	15	—	—	—	823	842	1,277
Chaco	114	6	4	—	—	—	1,438	1,448	3,171
Pampa	207	9	5	65	1	3	107	190	512
Neuquén	40	—	55	7	—	—	—	62	89
Rio Negro	83	—	52	4	—	—	—	56	205
Chubut	65	1	—	50	10	—	4	65	134
Santa Cruz	17	—	—	—	—	—	—	—	172
Tierra del Fuego	8	—	10	—	—	—	405	415	158
Los Andes	1	—	—	—	—	280	—	280	159
Total	31,988	956	9,820	3,808	4,377	21,790	188,909	229,660	329,490

being made will be apparent from the analysis which follows herewith.

The works and factories referred to do not include those of the Government, municipalities, railway companies, tramway companies, steam companies, irrigation, or other undertakings of a public or private character unless operated under the usual competitive conditions of trading.

A large percentage of the works and factories in the Argentine are only small workshops where but few hands are employed, and they cannot be considered as manufactories in the English acceptation of the word. Taking, for example, the industry represented by boot factories, brickworks, carpenters' shops, smithies, sawmills, printers, mechanics' shops, and similar trades, as listed in Table I, although these appear high in the list as regards the number of works and workpeople employed, the average size is quite insignificant at the present moment, and the capital employed is relatively small. At the same time they probably form the nucleus of larger works in the very near future.

The industries already established on a large scale, and the capital invested therein, may be taken to be as follows, viz. :—(*a*) Sugar mills, £15,000,000 ; (*b*) Wine presses, £14,000,000 ; (*c*) Electricity works, £10,000,000 ; (*d*) Gas works, £9,500,000 ; (*e*) Flour mills, £8,000,000 ; (*f*) Frozen meat industry, £6,500,000 ; (*g*) Breweries, £6,000,000 ; (*h*) Tanneries, £2,500,000 ; (*i*) Tobacco factories, £2,000,000 ; (*j*) Boot factories, £2,000,000 ; (*k*) Paper works, £1,500,000.

In addition to these, there is one sugar refinery with a capital of £700,000 ; one wool-washing works with a capital of £600,000 ; one cotton-thread works with a capital of £200,000 ; and one gold mine with £650,000 capital.

These represent a capital of £79,150,000, out of a total capital for all works of £146,000,000.

With respect to "output," the annual value is greatest in the cases of flour mills and the meat preserving industry, each of which has an annual turnover of £20,000,000. Next in order of importance come the wine, bread, sugar, tobacco, spirits, and boot industries. The total value of the production of the whole of the factories in 1910 was £245,500,000.

On reference to Table I, it will be seen that the most important item for motive power is that of the electricity works, which account for 80,826 H.P. This industry, however, has made such rapid strides, that at the end of 1912 the figure is nearly doubled. The Campania Alemana Transatlantica de Electricidad, which supplies current for lighting, heating and power purposes for a portion of the City of Buenos Ayres, has generating machinery of 100,000 H.P., and this, it is anticipated, will reach 150,000 H.P. in another 12 months. For some inexplicable reason the Government has not included in its Blue Book issues any data of the many tramway companies in the Republic, but these have large independent power works and employ many thousands of hands. A tramway, of course, is not strictly a factory or works, but in England it comes under the Factory Acts. The Anglo-Argentine Tramway Co. in Buenos Ayres employs over 8,000 men.

Another interesting feature in this very cosmopolitan country is the nationality of the proprietors of the works and factories. These are given as in Table IV.

TABLE IV.—Nationality of the Proprietors of Works.

Provinces and territories.	Argentines.	Foreigners.	Mixed.	Total.
Federal capital ...	1,347	8,107	973	10,427
On the coast	2,332	10,213	1,565	14,110
Central	322	1,326	193	1,841
Andes	1,149	1,392	1,077	3,618
North	474	432	309	1,215
Territories	126	487	164	777
	5,750	21,957	4,281	31,988

A reference to a map of the Argentine in conjunction with Table III will indicate more clearly the disposition and location of the industries. In nearly all cases the works are situated in and around the capitals of the provinces, and the other towns. For instance, the centre of the sugar industry is located at Tucuman ; the wine industry at Mendoza ; the frozen meat industry in and around the City of Buenos Ayres and La Plata ; electricity works in most of the towns of over 5,000 inhabitants ; breweries, tobacco factories, boot factories and paper mills within the Federal capital.

(To be continued.)

THE LOADING OF SUBMARINE TELEPHONE CABLES.

A Comparison between Coil-Loaded and Continuously-Loaded Cables.

By J. G. HILL.

(*Concluded from page* 933.)

If n be taken at 1,000 and μ at 110, the formula becomes—

$$11{\cdot}79\ t^3/\rho\ (d + t) \text{ ohms per km.} \qquad (19)$$

As an example, take the conductor with a resistance of 8ω per km. in Table VI, taking ρ at 150×10^{-3}. The values of t and d corresponding to this conductor are given in the tables, and the above formula becomes—

$$\frac{11{\cdot}79 \times (0{\cdot}323)^3}{150 \times 10^{-3}\ (2{\cdot}371 + 0{\cdot}323)} = 0{\cdot}{?}83.$$

t represents one thickness of iron. If there are several windings, each of thickness p, then pt replaces t in the approximate formula (19).

$d + 2t$, and it can be shown that the relation of the weight of gutta-percha for equal capacities in the two types of cables is as given in the following equation—

$$W_1 = (1 + 2\ t/d)^2\ W, \qquad (20)$$

where W_1 is the weight of gutta-percha required to give the same capacity in a continuously-loaded cable, as the weight of gutta-percha W gives in a coil-loaded cable, t is the thickness of the iron winding, and d is the diameter of the conductor used for both cables (the assumption being that circuits of equal ohmic resistance are being dealt with).

It may be seen that so long as the ratio t/d is unaltered, the expression $(1 + 2\ t/d)^2$ is unaltered. This means that, in order to keep the capacity in the continuously-loaded cable the same as in the case of a coil-loaded cable having the same gauge of copper conductor, the gutta-percha in the former must always be a fixed percentage heavier than the gutta-percha required for an ordinary cable, and this percentage obviously depends on the thickness of the iron wire, and therefore on the amount of inductance added. In the case where the inductance is 16 mh. per naut, the thickness required is that given in Tables IV and VI, and the increase in gutta-percha is in every case 62 per cent., as compared with that required to give a coil-loaded cable the

TABLE IV.—Weights and Dimensions of Copper, G.P. and Iron Windings, with Constant Circuit Capacity = ·167 mf. per naut or ·09 mf. per km. at 1,000 pps. and Different Conductor Resistances.

Coil-loaded cable.										Continuously-loaded cable.							
Per naut.					Per kilometre.					Per naut.				Per kilometre.			
R.	d.	D.	Weight of g.p.	Weight of Cu.	R.	d.	D.	Weight of g.p.	Weight of Cu.	t.	$d + 2t$.	D.	Weight of g.p.	t.	$d + 2t$.	D.	Weight of g.p.
	mils.	mils.	lb.	lb.		mm.	mm.	kg.	kg.	mils.	mils.	mils.	lb.	mm.	mm.	mm.	kg.
3·71	187	524	503	615	2	4·743	13·30	123	150·8	25·5	238	667	814	0·646	6·035	16 93	199·4
7·42	132	370	251·5	308	4	3·354	9·40	61·5	75·4	18·0	168	472	407	0·456	4·266	11·97	99 7
11·13	108	303	167·7	205	6	2·738	7 68	41	50·27	14·7	137	385	271·3	0·373	3·484	9·77	66·46
14·84	93	262	125·75	154	8	2·371	6·65	30·8	37·7	12·7	119	333	203·5	0·323	3·017	8·46	49·85

R = Loop resistance of cable per unit length; d = diameter of copper conductor; D = diameter of g.p. core; t = thickness of iron winding.

We are now in a position to proceed with the consideration of the cost of providing loaded cables of the types under review, and Tables IV and VI have been calculated to permit of this being done. Table IV gives the dimensions and weights of the principal materials required for cables having the efficiencies shown in Table II, including the thickness of the iron winding t necessary to give 16 millihenrys inductance per naut for continuously-loaded cables, and also the amount of gutta-percha required to give a capacity of $0{\cdot}09 \times 10^{-6}$ farads per km., together with the weight of copper involved. Table VI gives corresponding details for use in connection with Table V.

same capacity. The actual value of the capacity does not affect the matter so long as it is the same in both cases, the percentage given will hold for *equal* capacities so long as 16 mh. per naut is required, and the thickness t of the iron given is necessary to produce it. The effect of this added gutta-percha would be to increase greatly the cost of continuously-loaded cable as compared with coil-loaded cable, even if the β of the former were not, on the whole, much higher than that of the latter. The curves in fig. 1 show the relative cost of β in the two cases, assuming that ordinary gutta-percha is used, the assumption being that the capacity is equal in the two cases, and that it is constant in all cases. The relative

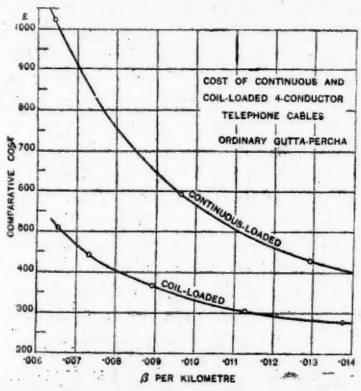

Fig. 1. (Based on Tables III and IV.)

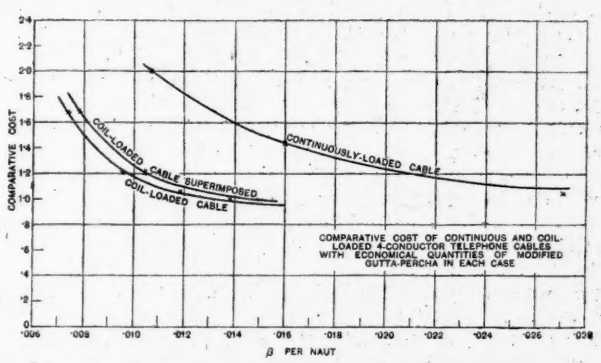
COMPARATIVE COST
CONTINUOUSLY-LOADED CABLE
COIL-LOADED CABLE SUPERIMPOSED
COIL-LOADED CABLE
COMPARATIVE COST OF CONTINUOUS AND COIL-LOADED 4-CONDUCTOR TELEPHONE CABLES WITH ECONOMICAL QUANTITIES OF MODIFIED GUTTA-PERCHA IN EACH CASE
·006 ·008 ·010 ·012 ·014 ·016 ·018 ·020 ·022 ·024 ·026 ·028
β PER NAUT

Fig. 2. (Based on Tables V and VI. The cost of the cheapest cable in the tables is 1·0.)

In order to keep continuously-loaded cables equal in capacity to coil-loaded ones, it is fairly evident that the weight of gutta-percha must be increased, as the capacity of coil-loaded cables depends upon the ratio D/d as given in Tables IV and VI. Now d is increased by the iron winding to

β's in the two cases are given in Table III, and on the cost of cables to provide those β's the price is based. It will be seen that for small values of β, the cost is twice as great in the case of the continuously-loaded cable as in the case of the coil-loaded cable, but that the difference

TABLE V.—Electrical Constants and Corresponding "β's" in Cables with Economical Quantities of Gutta-percha consistent with Safety.

Coil-loaded Cables (without Superimposing Coils) with Minimum Quantity of G.P.

Per naut.								Per kilometre.					
Cond. R.	Coil B_1.	S/K.	B_1/L.	K.	L.	β.	$\sqrt{L/K}$.	Cond. R.	Coil R_1.	K.	L.	β.	$\sqrt{L/K}$.
3·71	3·12	12	60	$1·98 \times 10^{-7}$	52×10^{-3}	$7·27 \times 10^{-3}$	512	2	1·68	$10·7 \times 10^{-8}$	28×10^{-3}	$3·92 \times 10^{-3}$	512
7·42	6·18	12	60	1·73 „	103 „	9·64 „	771	4	3·36	9·3 „	56 „	5·2 „	771
11·13	6·18	12	60	1·67 „	103 „	11·81 „	784	6	3·36	9·0 „	56 „	6·37 „	784
14·8	6·18	12	60	1·57 „	103 „	13·76 „	806	8	3·36	8·46 „	56 „	7·42 „	806
Coil-loaded Cables with Extra Coil for Superimposing.													
3·71	3·21	12	72	$1·98 \times 10^{-7}$	45×10^{-3}	$7·8 \times 10^{-3}$	477	2	1·73	$10·7 \times 10^{-8}$	24×10^{-3}	$4·22 \times 10^{-3}$	477
7·42	6·4	12	72	1·73 „	89 „	10·38 „	717	4	3·45	9·3 „	48 „	5·6 „	717
11·13	7·48	12	72	1·67 „	103 „	12·5 „	784	6	4·03	9·0 „	56 „	6·74 „	784
14·84	7·48	12	72	1·57 „	103 „	14·49 „	806	8	4·03	8·46 „	56 „	7·81 „	806

Continuously-loaded Cables (same Capacity as Coil-loaded Cable).

Per naut.								Per kilometre.					
Cond. R.	Added B_2.	S/K.	B_2/L.	K.	L.	β.	$\sqrt{L/K}$.	Cond. R.	Added R_2.	K.	L.	β.	$\sqrt{L/K}$.
3·71	1·76	12	110	$1·98 \times 10^{-7}$	16×10^{-3}	$10·0 \times 10^{-3}$	284	2	·96	$10·7 \times 10^{-8}$	$8·7 \times 10^{-3}$	$5·4 \times 10^{-3}$	284
7·42	1·76	12	110	1·73 „	16 „	15·34 „	304	4	·96	9·3 „	8·7 „	8·28 „	304
11·13	1·76	12	110	1·67 „	16 „	21·1 „	310	6	·96	9·0 „	8·7 „	11·37 „	310
14·8	1·76	12	110	1·57 „	16 „	26·23 „	320	8	·96	8·46 „	8·7 „	14·14 „	320
Continuously-loaded Cables with Minimum Quantity of G.P.													
3·71	1·76	12	110	2·25	16×10^{-3}	10·62	267	2	·96	12·1	$8·7 \times 10^{-3}$	5·72	267
7·42	1·76	12	110	1·88	16 „	16·00	291	4	·96	10·14	8·7 „	8·62	291
11·13	1·76	12	110	1·73	16 „	21·5	304	6	·96	9·3	8·7 „	11·6	304
14·8	1·76	12	110	1·68	16 „	27·05	307	8	·96	9·0	8·7 „	14·56	307

TABLE VI.—Weights and Dimensions of Copper, G.P. and Iron Windings in Cables with Economical Quantities of Gutta-percha consistent with Safety.

Coil-loaded Cables with Minimum Quantity of G.P.

Per naut.					Per kilometre.				
R.	d.	D.	Weight of g.p.	Weight of copper.	R.	d.	D.	Weight of g.p.	Weight of copper.
	mils.	mils.	lb.	lb.		mm.	mm.	kg.	kg.
3·71	187	449	350	615	2	4·743	11·4	85·7	150·8
7·42	132	360	235	308	4	3·354	9·14	57·5	75·4
11·13	108	303	167·7	205	6	2·738	7·7	40·9	50·27
14·8	93	279	145	154	8	2·371	7·08	35·5	37·7

Continuously-loaded Cable with same Capacity as Coil-loaded Cable.

Per naut.				Per kilometre.			
t.	$d + 2t$.	D.	Weight of g.p.	t.	$d + 2t$.	D.	Weight of g.p.
mils.	mils.	mils.	lb.	mm.	mm.	mm.	kg.
25·5	238	571	567	0·646	6·035	14·5	138·8
18·0	168	458·6	380·7	0·456	4·266	11·64	93·2
14·7	137	385	271·3	0·373	3·484	9·77	66·46
12·7	119	357	234·9	0·323	3·017	9·06	57·5
Continuously-loaded Cable with Minimum Quantity of G.P.							
25·5	238	512	432	0·646	6·035	12·97	105·9
18·0	168	420	311	0·456	4·266	10·66	76·2
14·7	137	370	248	0·373	3·484	9·39	60·8
12·7	119	333	203	0·323	3·017	8·45	49·7

t = thickness of iron winding.
d = diameter of conductor.
D = diameter of dielectric.
R = loop resistance per unit length.

in price gradually becomes less as the β gets higher, owing to the fact that the expensive item, gutta-percha, becomes a less prominent factor in the total cost, and the manufacturing cost becomes a greater proportion of it. The quantities and prices on which the estimate is based are made up on a manufacturing basis and have been independently supplied for purposes of *comparison*. The *actual* cost is not the main consideration in this case, and the table is merely given for comparative purposes.

It should be remarked that the amount of gutta-percha required to give a capacity of ·09 mf. per km. is considered to be rather too small for safety in the case of the coil-loaded cable with a resistance of 8$^{\omega}$ per km., and is unnecessarily large in the case of some of the other cables. It is always the cheapest method to obtain efficiency in a loaded cable by the use of the smallest quantity of gutta-percha consistent with safety. I have, therefore, calculated the cost of the most expensive items in such cables and plotted the *relative* cost of β on that basis; this gives very approximately the comparative prices of the cables. The efficiencies and dimensions of the cables are shown in Tables V and VI, and the curves in fig. 2 give the comparative cost of β. It will be seen that the comparison is again greatly in favour of the coil-loaded cable. Of course, the comparative cost depends to some extent on the cost of materials and labour, and is not an invariable quantity. As a basis of comparison, gutta-percha has been taken at 6s. 8d. per lb., copper at £4 10s. per cwt., and the special kind of sheathing wire used by the Post Office at £16 per ton.

Now the actual cost of heavy-gauge cables is in any case very great, and such cables would only be required for long-distance cable service. If a cable 250 nauts in length were required, it is very doubtful whether a paying commercial service could be provided in the case of a continuously-loaded cable, owing to its high cost, combined with the fact that the βl of such a circuit would be 2·65, against 1·82 in the case of the coil-loaded cable (see Table V), which could be provided much more cheaply.

In view of the foregoing facts, it appears clear that a coil-loaded cable is of greater electrical efficiency, and therefore is to be preferred to a continuously-loaded submarine cable of the type examined, if it can be satisfactorily maintained. It follows from the nature of the case that it is not possible to state absolutely the life of such a cable, and this is, of course, a necessary consequence of its recent introduction, but the Anglo-French loaded cable has now been immersed nearly 2½ years, and has not yet required any attention whatever. The Anglo-Belgian cable also has not been interrupted since it was handed over to the Post Office by the contractors. Those who have the greatest knowledge of the design of such cables, moreover, do not anticipate any exceptional difficulty in the future.

So far as continuous loading is concerned, considerable attention has been, and doubtless will continue to be, devoted

to its development, but even if it be assumed that material progress is made, now or at an early date, the increase in the diameter of the conductor brought about by the iron wrapping, and the necessity for an increased weight of gutta-percha as compared with a coil-loaded cable, would in any case appear to be a serious drawback to it. The type of continuous-loading examined in this paper, that produced by the Telegraph Maintenance & Construction Co., represents good work in that direction, inasmuch as the speaking range of the cable so loaded was rather more than doubled, as compared with an unloaded cable. It will, however, be necessary to decrease the ratio $R_2/L = 110$, and to increase considerably the permeability of the iron winding before continuous-loading can be considered to be electrically equal to coil-loading as an efficient electrical device.

Erratum.—In connection with equation 11, page 932, it should have been stated that "2 d is the distance between the centres of the conductors," not "d" as previously stated

COSTING.

[communicated.]

Costing is a common generic term denoting any systematic procedure of recording the elements of the cost of production, output, construction, or whatever suitable appellation may be given to the result achieved. The ingredients of costing are naturally those of labour, materials, and expenses, and the art of costing may be said to consist of the display of such knowledge and skill as are necessary in recording and allocating the details or minutæ of these factors, so that they may be of practical utility for the purpose which they are intended to serve.

Subject to the prevailing degree of personal opinion and point of view, which loom largely in matters of classification and in other respects, and which not infrequently are mere distinctions without differences, we may exhibit the general composition of cost in the following manner :—

1. Wages	Prime or flat cost.			
2. Materials				
3. Direct expenses—*e.g.*,				
Wages				
Rent	Plant, machinery, buildings, &c.	On cost.	Total cost.	Selling price.
Insurance				
Rates				
Repairs and maintenance				
Water				
Light (and other charges)				
4. Indirect expenses—*e.g.*,				
Directors' fees				
Office rent and salaries				
Travellers' salaries, commissions and expenses				
General expenses				
Warehouse wages and expenses (and other expenses)				
5. Profit				

All methods or systems of remunerating labour owe their existence to the following principles :—

1. Day work, *i.e.*, paying for the time spent on work.
2. Piecework, *i.e.*, paying for the quantity of work done.

Let us notice some of them.

Differential piecework rates may be stated as meaning a high rate of pay for a definite high or large production, with a lower price if such definite production be not attained. For instance, if the maximum number of operations, or products, as the case may be, for a workman, be 20 per day, and the rate 8d. per operation or product, he would receive 13s. 4d. if he performed the work satisfactorily. Should the quality of the workmanship be indifferent or below the recognised standard, he might be entitled only to a 7d. rate, or it might be graded, that is to say, if ten operations were performed satisfactorily he might receive therefor an 8d. rate, if six, then a 7d. rate, with a minimum rate of wage per diem.

One of the principle defects of piecework remuneration is that of "cutting," or reduction of rate, and if it be cut the workman soon discovers the length he can proceed without incurring risk of reduction, and limits his production accordingly. Absolute or fixed piecework rates are those which are, of course, fixed, but usually without the grading to which we have alluded.

We may here note some of the premium or bonus methods in vogue. As is well known, the basis generally embraces an hourly rate with a standard time for each operation or job, the workman receiving in addition to his hourly rate of pay a premium, or a proportion of a premium, the monetary value of which varies according to the intensity of production, or the time saved on the completion of the job. Let us suppose the following data :—

Time allowed, 54 hours; hourly rate, 9d.; workman actually completes the specific work in 49 hours.

1. The workman receives 49 hours at 9d. ... ... 441d.
   Saving on standard time 5 hours at 9d. = 45d.
   One-third of ... ... 45d. 15d.
   456d.

   = 456/49 per hour for the work.

2. Or 49 hours at 9d. ... ... 441d.
   Saving 5 hours at 9d., 45d., one-half thereof ... 22·50d.
   463·50d.

   = 463·50/49 per hour for the work.

3. Or 49 hours at 9d. ... ... 441d.
   $\frac{1}{10}$th of 49 hours = $4\frac{9}{10}$th hours at 9d. ... ... 44d.
   485d.

   = 485/49 per hour for the work.

Taking 54 hours as the time of an ordinary week's work, it will be perceived that the workman in the usual course without earning any premium, would receive 486d. for the week, *i.e.*, 54 at 9d., as against—

Detail.	Case 1.	Case 2.	Case 3.
49 hours	441d.	441d.	441d.
Bonus	15d.	22·50d.	44d.
5 hours at 9d. ...	45d.	45d.	45d.
	501d.	508·50d.	530d.

It is not clear why, of the total premium earned by the workman, the employer should participate therein to the extent of two-thirds in Case 1 and one-half in Case 2. If the workman were paid the whole of the premium earned, he would be entitled, for his week's work, to 531d., to which Case 3 approximates.

It is often stated that, in the industrial world, the employer seeks to obtain the labour that he requires for the least possible pay, whilst the workman seeks the highes remuneration for the minimum amount of labour. As a step towards substituting some measure of practical confidence and goodwill for the present and long-existing antagonism, the principle of co-operation, profit-sharing, or co-partnery, which in various forms is in restricted evidence to-day, seems to be accorded only a mixed acceptance, and consequently has its detractors as well as its supporters. Only by some such means, it is often averred, can the establishment of confidence between capital and labour, the encouragement of production, and the security of economical and excellent workmanship, be realised. Some who favour the idea go so far as to say that the principle is applicable to all forms of business with general success, that it produces good results by getting men to work more intelligently and with less waste, whilst it brings out more sympathetic management, and that some losing concerns by adopting co-partnery usually "turn the corner." Others emphasise its unsuitableness for some businesses. Some allege that the principle is not worth while pursuing, and that a liberal system of piecework or bonus remuneration acts much more to the pecuniary advantage of the employé than that of profit sharing. Where the employer, whether he be in the form of an abstract entity or otherwise, obtains money at, say, 4 per cent., and lends it to the employés at, say, 5 per cent., to give effect to profit-sharing proposals, the principle seems to be, it is sufficient to state here, objectionable.

An effective system of costing implies the efficient purchase of stores and materials for consumption in manufacture or construction, and an efficient system of storekeeping for the reception, custody and issue of stores, whilst it is desirable that the cost accounts should be interlocked with the principal books of account.

Referring to the appropriation of direct and indirect charges where numerous or many varied jobs, orders or contracts, are in course of execution, some of the former charges in their entirety may be readily allocated to a job, whilst many others necessitate apportionment in the process of arriving at their final destination. What the basis of apportionment should be —and this may vary as between certain forms or descriptions of expenditure —will depend upon the decisions arrived at from a practical consideration of the precise circumstances. As to indirect charges, these are for the most part inherently of an apportionable character if in some instances there be any special object to be attained in so exhausting them over the cost accounts. It is necessary to bear in mind that apportionment in costing merely means in this case estimating, and that to the extent that costs contain computations of this character, they are naturally estimated.

In many cases a large production is essential to the profitable working of a company having regard to the amount of capital sunk therein (though the Companies' (Consolidation) Act provides a means for removing the incubus of lost capital), and to the narrow margin of profit made, and generalising in this connection we may conclude our elementary notes with the introduction of efficiency, increased capacity of plant, and on cost, the latter varying as it does with output. For instance :—

To materials	£20,000	By sales	£40,250
,, wages	9,000		
,, on cost	6,000		
,, profit (15 per cent. on cost)	5,250		
	£40,250		£40,250

If the sales be increased to £80,500 owing to the doubling of the plant, we may have :—

Materials	£40,000	By sales	£80,500
Wages	17,000		
On cost	9,000		
Profit (say 22 per cent. on cost)	14,500		
	£80,500		£80,500

Supposing that it be unnecessary to double the machinery installation, as after careful consideration of the details of the operations of the workmen and of the existing production machinery and appliances, it is estimated that the increased output can be obtained by some slight extensions and improvements and by greater labour efficiency, we may have :—

Materials	£40,000	By sales	£80,500
Wages	13,500		
On cost	8,000		
Profit (say 30 per cent. on cost)	18,500		
	£80,000		£80,500

On this basis (first and third examples)—

£35,000 on £40,250 = say 87 per cent.
£61,500 on £80,500 = say 76 per cent.

a decrease in cost of 11 per cent.

Particular attention should be paid to the item of on cost, by which is here meant every addition to revenue expense, financial, administrative, distributive, or of whatever nature, and whether it be fixed or fluctuating. Its relativeness to its neighbours of labour and materials should be under constant supervision, and to be of value it should be comprehensive of suitable detail. G. J.

The Electrical Refining of Nickel.—It is reported from Kristiansand that the Kristiansand Nickel Refining Works, which only a short time ago increased their capital and extended their plant, have now decided on further extensions so as to be able to double their present production. This extension may have some connection with an invention that was made a short time ago, viz., an electrical refining furnace for nickel. Experiments with such a furnace have been in progress for some time at the Technical College at Trondhjem, with good results, and it is anticipated that the furnace will prove as satisfactory for commercial purposes as it already has proved to be in metallurgical respects. It is stated that this furnace is the first of its kind in which metallic nickel can be produced by an electrical process. The Zigeland Aluminium Manufactory, which is also situated in the neighbourhood of Kristiansand, is now worked to its full capacity, but as the demand for aluminium has increased lately, it has been resolved to increase the production further by erecting a new building and equipping it with the necessary plant. The cost of the building alone will mount to £5,555, apart from the plant.

PROCEEDINGS OF INSTITUTIONS.

Earthed v. Unearthed Neutrals on Three-phase A.C. Systems.

(*Discussion on paper read by* Mr. J. S. Peck, *before the* Institution of Electrical Engineers, *at Birmingham, November 27th*, 1912. *For abstract of paper see p.* 935.)

Mr. R. A. Chattock agreed that with 10,000 volts and upwards it was probably beneficial to earth ; but below this voltage he did not consider that it was necessary. In Birmingham, on their 5,000-volt three-phase 25-period system they had not yet found the slightest necessity for earthing, and they did not propose to do so as long as the conditions remained as satisfactory as at present. While he admitted that an earth on one phase generally produced a complimentary earth on another phase, and a short circuit occurred, he had known cases in which an earth on one phase had developed and it had been possible to maintain the supply for some considerable period until this earth had been located and rectified. With an earthed neutral under such conditions a section of the supply would have been automatically cut off. Maintenance of supply was one of the chief points that supply undertakings had to consider, and any arrangement that tended to carry this out should always receive first consideration. The second point was the greater safety to human life in case of accident. With an earthed system, if a man touched one of the phases he was bound to be killed, but more than one case had been known in which on an unearthed system, a man had accidentally touched one of the phases, and had not been killed. The third point was the complication and the unsatisfactory nature of the arrangements used for earthing. Mr. Peck described two or three methods of earthing, and advised trying one, and if it were found to be unsatisfactory, then another should be tried. This did not look as if the methods adopted were at all standardised. If the generator neutrals were connected solidly together, there appeared to be liability of large currents circulating in the windings, the effect of which, superimposed upon the wattless currents which circulated in the generator windings under conditions of low-power factor, must be very serious on the heating of the generators, and must cut down the capacity of the machines to handle useful load. These circulating currents depended upon the wave-form of the alternators, and it was highly probable that the wave-forms of machines designed by different people would be dissimilar, the result being that it was impossible to prophesy what quantity of circulating current would have to be dealt with. The alternative to this was to connect one generator neutral to earth, and this had to depend upon the attendant in charge, or else upon the very complicated apparatus installed at the London County Council power station at Greenwich, which was so complicated that, under prolonged use, there was no doubt trouble would be experienced. Again, with one machine coupled to earth, in case of a fault on one phase, it was quite likely that the overload circuit-breakers on this particular machine would be opened at the generating station, and the system would then be running unearthed just at the time when further trouble was most likely to appear. In Birmingham they had designed their high-tension cables to stand the full voltage to earth on any phase rather than cut down the insulation, as was possible with an earthed system. He considered that economy of this kind was far from advisable, and the results obtained in Birmingham had fully justified this provision. Very few breakdowns to earth of any kind had been experienced, and these had always occurred in connection with broken insulators in the switchgear, or coils in generators. He considered, therefore, that for a system having a pressure up to 10,000 volts, it was certainly better to allow a large factor of safety in the insulation, and to run with an unearthed neutral.

Mr. F. Forrest said that in considering the earthing of the neutral of any three-phase transmission system, the factor of safety of its insulation to earth should largely determine this point. By the factor of safety of the insulation was meant the ratio between the normal working voltage to earth (in all systems whether earthed or not this was $\frac{1}{3}$ of the voltage between phases) and the voltage to earth which would cause breakdown when continuously applied under the worst atmospheric conditions likely to be met with. In the case of bare overhead transmission lines working at voltages above 50,000 between phases, this factor of safety was usually about 2·5. In order that this factor of safety might be maintained, and also in order to save a large additional capital expenditure for insulators, such transmission lines should always be operated with an earthed neutral. In this country, where voltages were comparatively low and underground systems prevailed, the factor of safety was usually much higher than 2·5, and the question of earthing would largely be decided by other considerations. One of the chief points in favour of earthing the neutral was the question of lightning or pressure arresters. If full use was to be made of these, they should be set to spark over at a voltage 25 per cent. in excess of the normal working pressure to earth, so as to clear the system of all pressure surges, but if the neutral was unearthed, the arresters must be set so high that they were never likely to operate at all.

Dr. C. C. Garrard said that the sole advantage of the earthed neutral which we need consider in this country, was the possibility of cutting off any wire or feeder in the event of an earth upon it. Considering the case of a generator feeding a network of underground cables, if earthing of the neutral was adopted it must be through a current-limiting resistance. He agreed with Mr. Peck that the simplest method was to connect the neutrals all together on to one bus-bar, earthing this through a resistance. Even with turbines, however, heavy circulating triple-frequency currents

might flow. A case which came under his notice was with water turbines. Efforts were made to test the generator wattmeters under inductive load by altering the relative excitation of the machines. This, however, caused large cross currents to flow through the neutrals which were connected together, which upset the tests altogether. The method of balanced protected gear illustrated in fig. 1 was very interesting. Would Mr. Peck also advocate the protection of underground feeders by this method alone, or would he install overload protection in addition? The very clear exposition of the case of the generator supplying transformers which stepped up to a very high voltage, in which Mr. Peck showed the absolute necessity for some form of earthing, would apply to sub-stations in which were situated step-down transformers feeding converters. In a sub-station fed by step-down transformers having a primary voltage of 10,000 and a secondary of 500 volts. The secondaries of the transformers, although heavily insulated, kept on breaking down to earth, and examination of the point of puncture showed clearly that it was the result of an abnormally high potential. The difficulty was obviated by putting a permanent leak on the low-tension side of the transformers by means of resistances connected between phase and earth. It was not possible to earth the neutral, as the transformers were delta-connected. He fully agreed with the author's condemnation of earth shields between the primary and secondary windings of transformers. He was very doubtful, however, of the utility of a spark gap in the earth connection; instead of the spark gap, a permanent leak from line to earth through resistance would be better if earthing of the neutral were impossible.

Mr. S. A. Mahood said the conclusions arrived at in the paper were not very convincing. His experience with a three-phase 5,500-volt, 25-cycle system, in which the neutral was earthed solid without any resistance between, had been quite satisfactory in actual practice for eight years. They had had no complications due to the way in which the system was earthed, and saw no reason why they should make any change.

Dr. W. E. Sumpner said that he favoured the view that the neutral should be earthed in all cases, except where it could be clearly shown that there was a great disadvantage in doing so. This opinion was based on general considerations of simplicity. A three-phase circuit really consisted of three circuits interlinked, except when the neutral was earthed, when the circuits were essentially separate. In the latter case a defect in one circuit was not likely to affect the others, though it might prove more serious in the circuit in which the defect occurred. On the whole it seemed preferable to localise the trouble, especially in view of possible dangers arising in high-tension systems from what were known as surges. These were likely to occur whenever a sudden change occurred in the circuit conditions, and they might give rise to much higher potentials than those indicated by a simple theory, such as that given by Mr. Peck in connection with fig. 2. At one time almost the only formula needed for electrical engineering was Ohm's law. Nowadays, with high-tension work, engineers were face to face with what might be called the "lightning-flash" stage of theory, a theory which as yet no one had been able to make very simple, but in which they had to consider phenomena akin to lightning discharges and to wireless telegraphy.

Mr. A. M. Taylor thought that Mr. Peck had not proved the necessity for earthing the neutral on a low-voltage system such as that at Birmingham. To put in an earthing resistance sufficiently heavy to pass enough current to operate the feeder over-load trip gear, was quite out of the range of practical politics. Consider the serious interruption to supply that would result from cutting off even one feeder carrying 400 amperes at 5,000 volts. If the neutral were earthed this interruption was deliberately invited for even a trifling fault. In most cases the faults did not occur in the cable, but on the consumer's premises. Hence, it was much better to devise means to cut off the faulty consumer, rather than the whole feeder. The other alternative, viz., to install apparatus as in fig. 1, again assumed that the whole feeder had to be cut off for the sake of a fault that might be quite unimportant. Mr. Chattock had already spoken of a case where the fault was on the system for over an hour, and was cleared without affecting anyone but the consumer concerned, and the speaker knew of other cases. Moreover, the arrangement shown in fig. 1 gave no protection against shorts between phases. As regarded working with the arrangement in fig. 1, but having no earth whatever, this was only possible on very large systems having a capacity current of perhaps 100 amperes and many feeders. Even then there tended to be an operation of the relays on all the feeders, and not only on that on which the fault had developed.

Dr. Wall asked the author whether he had any data as to the magnitude of the equivalent capacities as shown in fig. 2, and whether it was likely that the capacity currents would ever cause an appreciable amount of heating.

Mr. T. P. Wilmshurst said with an earthed neutral on a star-connected system, the voltage between any phase and earth could not exceed 58 per cent. of the line voltage, and in consequence a smaller dielectric thickness might be used. The difference in cost between a cable built for work with an earthed neutral and one built for non-earthing was about 7 per cent., and this might amount to several thousand pounds on a large system.

The Faraday Society.

"The Billiter Alkali-Chlorine Cells." Dr. A. J. Allmand presented a paper describing these cells, which are coming into extensive use on the Continent and in America, before the November meeting of the Society. In the opinion of the author, and as a result of personal observation of some of the plants at work, the newer type of Billiter cell, known as the "membrane" cell, is one of the most efficient electrolytic alkali cells now being operated on a technical scale, but it does not seem to have attracted much attention in this country. The earlier type of cell (Billiter-Siemens) is a diaphragm cell, but it differs from others of its class in having horizontal instead of vertical diaphragms. Apart from the disadvantage of occupying more floor space, and being less accessible, the horizontal cell seems to have the balance of advantages, for the diaphragm is attacked more slowly chemically, and the hydrostatic pressure upon it being uniform, there is a more uniform flow of liquid through it, and consequently a more efficient checking of the movement of the OH' ions towards the anode, and thus greater electrochemical efficiency. The diaphragm in this cell consists of a mixture of asbestos wool and barium sulphate spread out on top of a sheet of asbestos cloth that is carried by the iron network forming the cathode. The cathode makes contact with the iron bottom of a

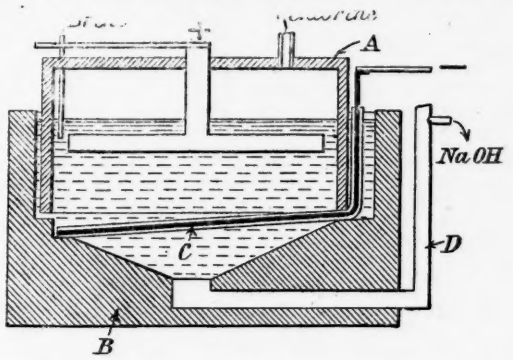

Fig. 1.

trough, the sides of which are lined with cement, and the anode chamber is formed by a non-conducting bell-jar which is cemented around the edges of the diaphragm. The electrolyte is heated by means of earthenware pipes immersed in the brine at the top of the bell-jars. Working at 85-90°, 12 to 16 per cent. caustic soda, or 18 to 20 per cent. caustic potash can be made at a 95 per cent. cathodic current efficiency with a voltage of 3·5. The process is now in operation at the following places:—

(*a*) In Aschersleben, Saxony, by the Kaliwerke Aschersleben A.G. Ten 2,000 ampere units.

(*b*) In Höchst, by the Farbwerke Höchst.

(*c*) In Brückl, Bosnia, by the Bosnische Elektrizitäts A.G. Sixty-four 2,500-ampere units.

(*d*) In Krumdu, Bohemia, by Ignaz Spiro und Söhne. Thirty-two 500-ampere units.

(*e*) At Niagara Falls, by the Niagara Alkali Co. A 1,000-kw. installation of 3,000-ampere units. This plant is now being increased from 1,000 to 3,000 kw. It has also been made known that a new factory for caustic alkali and bleach is being erected, commencing with 78 2,000-ampere units, and that a textile factory is installing 24 100-ampere units.

In the newer type of cell referred to above, the Billiter-Leykam cell, the diaphragm is done away with altogether, and the cathodes are hooded in asbestos tubes, as shown in fig. 2. The special feature

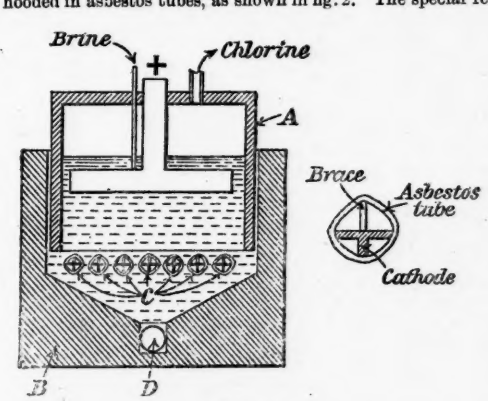

Fig. 2.

of the cell is that these cathodes are not placed at the sides of the bell-jar, as in other bell-jar cells, but immediately underneath it, as shown in the accompanying diagrams. This arrangement ensures uniform current density and also uniform flow both of electrolyte and of current between the anode and cathode, and the motion of the brine being directly opposed to that of the current lines, the OH^1 injection towards the anode is everywhere uniformly overcome. Hence high current densities can be used, stronger caustic liquors produced, high current efficiencies obtained, and large units constructed, while at the same time the essential advantage of the bell-jar cell, absence of diaphragm, is retained. The liquid which passes the cathode hoods—made of woven asbestos—is charged with caustic, and this

protects them from the chemical action of chlorine compounds; no purification of the brine is necessary at all. The only function of the hoods being to lead off the hydrogen gas (for which purpose the cathodes are slanted, as shown in fig. 1), they can be made quite coarse, so that their resistance is inconsiderable. The general construction of the cells will be quite apparent from the sectional diagrams, figs. 1 and 2. The cell B itself is made of reinforced concrete, the upper part being lined with earthenware bricks set in cement. In the plant at Gratwein, in Austria, there are 56 of these cells, each measuring internally 5·5 metres long, 1·1 metres broad, and 1·3 metres high. The cement lids A, which in practice are cemented with putty on to a shallow shelf cut out of the walls of the cells, together constituting the bell-jars, carry the Acheson graphite anodes. At Gratwein each cell has three lids, each carrying eight anodes, measuring 1·0 × 0·18 × 0·05 metre. Each anode takes 50 amperes at a C.D. of 1·6-1·7 amps./sq.dcm., so that every cell takes 1,200 amperes. The cathodes C are made of T-iron, and, as already indicated, they are enclosed in asbestos tubes, which carry off the hydrogen gas. The cathodes are 1 m. long, and the tubes are about 5 cm. broad; between each two there is a space of 5 to 8 mm. At Gratwein, some of the cells, at the time of inspection, were being worked at low temperature, and some were steam heated up to about 70° C. The voltage of the former was about 4, and of the latter 3·4 to 3·5. The brine is led from a reservoir to distributing boxes placed above each cell, proceeding thence by a series of short capillary tubes to 22 tin tubes, which pass through the cell lids. The causticised brine is drawn off by means of siphon overflows, shown diagrammatically at D. The cells are worked under slightly reduced pressure, so there is no escape of chlorine into the air.

The Gratwein plant, which is the first that has been installed, is in the paper factory of the Leykam-Josefsthal A.G. The plant has a capacity of 350-400 H.P., and it produces some 1,700—1,800 kg. of active chlorine daily at a total cost, as far as power is concerned, of £7 10s. per H.P.-year. The current efficiency is as high as 92 per cent. when the cells are worked at 85° C., and the voltage is then 3·1. The cathode liquors contain 12 to 13 per cent. caustic soda and about 20 per cent. salt, yielding, on evaporation and concentration, 97 per cent. caustic soda. A second installation of this cell is now being erected in Saxony.

At the same meeting papers were read by Mr. Ridsdale Ellis on "A Neutral Oil Emulsion as a Model of a Suspension Colloid," and by Mr. J. H. Stansbie on "The Electrolysis of Nitric Acid Solutions of Copper."

Mr. Ellis's work was carried out with a view to obtaining some quantitative data on the relations between the electrical charge carried by the particles of an emulsion, the surface tension on the oil-water interface, and the phenomenon of coagulation, with a view to throwing light on the nature of colloidal solutions, and particularly on the conditions which cause coalescence to occur. An emulsion, of course, contains in suspension particles very much larger than those of a colloid; in Mr. Ellis's experiments the size of the oil globules was about 2 μ, but in all probability there is no essential difference in the two classes. As coalescence or coagulation is deemed to be an electrical phenomenon, Mr. Ellis has studied the influence of the presence of acids and alkalies on the interface potential at the surface of the oil globules, by direct measurements on a microscope slide apparatus. He has found this potential to be altered enormously by acids, and to a lesser degree by alkalis. The maximum interface potential corresponded to a concentration of about 0·001 N alkali, and this was also found to be the point of maximum stability of the emulsion. Stability appeared to depend only on the interface potential, and not on the surface tension, as Bredij has taught. The explanation suggested by Prof. F. G. Donnan is that the presence of an electrical double layer around the particles prevents them from coming into sufficiently close contact unless the kinetic energy of the collision of two particles is sufficient to enable the electrical double layer to be disrupted, and if so the less chance there will be that two particles colliding with one another will coalesce or adhere to each other. Strong confirmation of this view is given by the data obtained in connection with the iso-electric point. According to the above theory, when the charge is zero there is no opposition to the force tending to produce coalescence or aggregation, so that in the case of a colloidal solution in which all the particles are in rapid movement or vibration, coagulation will occur extremely rapidly.

Indirect evidence that coagulation occurs at the iso-electric point is given by the ratio of concentrations of salts with mono-, di- and tri-valent kations required to just neutralise the charge on the oil globules, since the ratio of these concentrations forms a geometrical series agreeing with that obtained by coagulation experiments, a result, be it said, however, not confirmed by some experiments of Freundlich quoted by Dr. Senter.

In order to study the coagulation of one colloid by another of opposite sign, the coagulation of oil emulsions by colloidal ferric hydroxide was tried, and it was found that the oil was completely precipitated within two well-defined limits on either side of the iso-electric point of the oil emulsion. Mr. Ellis considers the coagulation here to be due to surface precipitation effects taking place between the oil globules, similar to the condensation of water vapour on surfaces of various curvatures. Thus when two oil particles come into contact there is formed at the point of contact the equivalent of a surface of negative curvature with a very small radius on which $Fe(OH)_3$ will very readily precipitate, thereby uniting the two particles together. This precipitation will not occur until the amount of the $Fe(OH)_3$ is sufficient to produce, in the short space of time the particles are in contact, a bond sufficiently strong to prevent the globules separating again by Brownian movement. When the globules are united in pairs, others will be joined to them in exactly similar manner until all the oil globules are held together in large columns cemented by ferric hydroxide.

Mr. Stansbie's short note explained in a very interesting way why it is not possible to deposit copper completely from nitric acid solutions. It appears that in the electrolysis of such solutions nitrous acid is formed, and it is the action of this or of nitrites which dissolves away the deposited metal. The presence of free sulphuric acid retards the formation of nitrous acid, and a rotating cathode also very effectively prevents redissolution, so that under proper conditions, all but the merest trace of copper can be deposited.

Roller and Ball Bearings.

At the Leeds University on Wednesday last week, Prof. Goodman lectured to the members of the Yorkshire Local Section of the Institution of Electrical Engineers on "Roller and Ball Bearings." He explained in detail the use of the testing machinery operating at the University, particularly emphasising the facilities that it afforded for measuring the end thrust, which, he said, was an extremely valuable accomplishment. The reason why there was end thrust on a roller bearing was that the roller was not perfectly parallel to the shaft as it rotated, and thus it tended to give in the direction normal to itself. If there was a millionth of an inch of error, the end thrust was just as bad as if there was an error of an eighth of an inch.

Discussing the extravagance of the claims made by some makers, he instanced in particular an American roller bearing guaranteed to be free from end thrust and with no friction which, on being put into the testing machine, proved to have so much end thrust and friction that the rollers were smashed. The last time he addressed them, he said, he had declared that there was not a single roller bearing on the market worth having, but since then he had found one which, so far as his tests had gone, was entirely satisfactory. They had tried to break it and could not; they had broken the shaft in their efforts, and had had to put in another, but the bearing remained as good as when it was put in. That was a bearing with a short roller. The length of the roller was only equal to the diameter. He had run it at a great overload, much beyond what the maker intended it for, and the results were still satisfactory. Some of these particular roller bearings had failed in actual practice, but he believed that the reason for the failure was that grit had got into them. It was most important to keep grit out of roller and ball bearings. These bearings ought to be as carefully guarded as the springs of a watch. The short roller bearings cost about 25 per cent. more than ball bearings, but they would carry twice the load. What the maximum load was he could not say definitely yet, because he had not yet smashed one of them. So far as his tests had gone, the short roller was an entire success. There was a little end thrust, but it was a negligible quantity.

With regard to ball bearings, he said that in the early days the makers thought that adjustment was necessary, and some of them did not appear to have got over the adjustment fit yet, but, as a matter of fact, there was no necessity whatever for adjustment, and they could not adjust a ball bearing if they wanted to. The early four-point bearing was good for light work, such as bicycles, but beyond that it was never used.

Later on thrust bearings came: 45° grooves were made for the balls to race in, and it was very soon found that the grooves were very badly scored, showing that they had been grinding. That type of bearing was wrong, because they could not increase or decrease the load without failure. The three-point bearing failed because of excessive friction and other faults. The two-point bearing was eventually found to be the proper thing, the friction being very much less and the load carried much higher. Then it was found that the hollow race was the right thing instead of the flat race. Hoffmann's were the first in this country to use the hollow ball race. If there was any doubt about being able to keep the shaft and the bearing in line, the flat race was the better. If they were certain of keeping everything in line, then the hollow race was unquestionably the right thing. A properly-fastened bearing with a hollow ball race would carry about twice the load that one with a flat race would.

The best practice was to make the radius of the groove 10 per cent. greater than the radius of the ball. The theory was that the closer they could make this groove fit the ball, the higher was the load that the bearing would carry; but the friction would go up at the same time. The friction was least on a flat surface, but it would only carry half the load, so they had to take into consideration all the circumstances of the case.

After discussing the effect of static friction, Prof. Goodman dealt with the use of an adapter. The fixing of the sleeve on the shaft, he said, was by far the most important problem connected with ball bearings, and four-fifths of the failures had been due to improper fixing. The man who worked to the nearest sixty-fourth of an inch went hopelessly astray. By far the best thing to do in preference to using the adapter, was either to make the shaft deeper and use a nut and fix it solid on the shaft, or have a ring bored out parallel and either forced on by hydraulic pressure or shrunk on. But they must be very careful in the shrinking. If they did not allow enough shrinkage it would get loose; if there was too much shrinkage it would jam the bearing. They would think they had got a 2-ton load upon it, when they had got 20. Thousands of ball bearings had been destroyed by getting too much shrinkage, or by forcing them on at too great pressure. The amount of shrinkage should be $\frac{1}{2000}$th part of the diameter, and if they materially departed from that they would have trouble. They should heat the ring in a bath of oil up to about 154° F., and if

then they could not get the ring on to the shaft, it would clearly prove that they had got too much shrinkage.

In most cases in which the maker was blamed, the fault was due to people using ball bearings carelessly. The housing of the bearings must be properly arranged. If the outer ring was fitted into a housing which was too small for it, as had frequently been done, even if it was only a thousandth of an inch too small, it would nip in the side when the load came on. If there was noise in the use of ball bearings, it was clear proof that they were doing something wrong. At the University they ran ball bearings under much more severe conditions than any in practice, and got no noise. Step bearings for heavy pressures he described as not a bit of good. In the Skefco bearing the shaft could move relatively to the housing to any extent. Whilst ordinary ball bearings were guaranteed to a ten-thousandth of an inch, the Skefco was made to a hundred-thousandth of an inch. It had been tested, terribly overloaded, with success.

With regard to rings, he said it was very important not to depart greatly from the spherical form—the simple form of ring. Emphasising the need of accuracy of workmanship, Prof. Goodman said if they were wrong to the extent of one-thousandth of an inch—say a thousandth over the inch—they would, approximately, increase the load of the bearing by 100 per cent. Hence there must be accuracy at all costs—wonderful accuracy. Whilst there were some firms in this country who worked to a millionth of an inch, if necessary, there were others who even yet hardly seemed to realise that there was anything less than an eighth of an inch, and the latter were the people who were always complaining of ball bearings. In the University they had carried out thousands of experiments in the attempt to find out the safe load and speed of ball bearings. They had been at it for 10 years, and they had found out how to get it.

If they looked at a ball under the microscope, as soon as ever they exceeded the safe load or speed, they would find it covered with fine specks where crystals had broken away. As soon as these specks appeared they might know to a certainty that the ball was damaged, and would ultimately fail; otherwise, if he had to run ball bearings until they failed, he would be as old as Methuselah before it occurred. The examination of the ball under the microscope had been a complete success. Speed was a most important point, and he illustrated on the blackboard the way in which they were able to find the relation between the speed of the ball and the safe load. He did not know why speed had anything to do with the matter. The wear of the balls was practically *nil* under proper conditions, even after very severe running. After dealing with some misconceptions of the rough-and-ready manufacturers as to the effect of slight variations in the sizes of the balls, Prof. Goodman spoke of lubrication. Provided that there was absolutely no rust at all, the balls would be better without lubrication, for oil or grease always increased the friction. Lard oil was the best lubricant. Lubrication was needed only for the sake of preventing corrosion, and once in 12 months was probably sufficient.

Speaking in conclusion of the general qualities of ball bearings, the lecturer said the friction was extremely low; with a properly fastened ball bearing, the starting effort was so small that they did not get a jump, and the friction was entirely independent of the speed. The ball bearing cost three times as much as the ordinary bearing to carry the same load, but the friction was less, no attention was required, and practically no lubrication, and an important point also in the case of a dynamo or motor was that the use of the ball bearing would shorten the shaft and shorten the bed. That was of very great importance, as they saved metal; but what was of importance also with regard to a motor was that the mechanical efficiency of the motor was very considerably higher with a ball bearing than with a plain bearing. So they could supply a smaller machine with ball bearings to give the same horse-power that a much larger machine would give if it had plain bearings. If they asked makers to quote for motors with and without ball bearings, they would find that in many cases the quotations would be lower with ball bearings than with plain bearings.

It was true that there were some people who said they would not have ball bearings at any price. They were generally people who had not yet learned that there was anything smaller than one-eighth of an inch—the rough-and-ready people.

Discussion.

The Chairman (Mr. Wilson Hartnell) said it would appear that roller bearings, except the narrow sort, were practically out of it. Ball bearings would last a great length of time under proper conditions, one of which was that they should fit tightly on the shaft. In putting a ball bearing on an alternating-current dynamo, however, they were met with difficulties, and he had found that there was a danger of cracking. From experience in the working of dynamos, it appeared that every shaft with ball bearings should have an end-thrust collar on it. He knew of a case of roller bearings running very well for many years.

Mr. T. Harding Churton said a great deal of the trouble with ball bearings in electric motors appeared to have been due to the high speeds at which these motors usually ran, but he thought that a more productive cause of trouble was a failure on the part of the makers in many cases to realise the imperative necessity for accuracy in the fitting of the housing of the ball bearings. He had confined his attention with regard to ball bearings to relatively small machines, and he had been absolutely free from trouble.

Dr. Pohl said that the earlier experiments with ball bearings in electric motors in Germany ended in complete failure, and he believed the reason for this was the inaccuracy of the ball bearings themselves. Some years ago he induced his firm to start afresh with ball bearings and roller bearings, and the result had been unqualified success from every point of view. The first thing they discovered was that if they wanted to use ball and roller bearings they had to employ machines of much greater accuracy than those which they had been using. The new ones they had used for over four years, and they had turned out in that period at least 3,000 to 4,000 motors, and the number of complaints that they had received since, was only a fraction of those that they had received before. The chief trouble in electrical motors was the presence of oil, and he attributed the diminution of complaints entirely to the absence of oil. The great point was the accuracy of the machine, and that applied, perhaps, even more to the housing than to the shaft—an easier fit on the outer race, and a tighter fit on the inner race, and making absolutely sure that the inner race did not revolve on the shaft. As to lubrication, he had known cases of friction being increased to such an extent from this cause that the bearing got hot, and they had to stop the lubrication altogether. A great point in connection with ball and roller bearings was that it was so extremely simple to make them dust-proof.

Mr. J. W. Dawson said that in communications with motor-car manufacturers he had pointed out that at least the inner races should be a tight fit on the shafts, and the outer races should be a fit in their housing. He had to object to bearings which were quite loose both in the outer and the inner housing. End thrust would be very simply dealt with if they had a combined bearing which would take both end thrust and the ordinary load. The weakness of the bearing ordinarily was its inability to carry any large proportion of the end thrust. The L.C.C. tramways had tried ball bearings, and found that at the end of 11,000 miles the bearings were as good as when they were put in, but in spite of that the motor manufacturers said "No." If they could bring into general use for tramway motors either the short roller bearing or the ball bearing, there would undoubtedly be a great saving.

Prof. Goodman, in replying to the discussion, said a good many people wanted him to tell them which were the best ball bearings, but he would not tell them, as it was unfair. Some of the lists were woefully wrong. He knew several firms who had put roller bearings on crank-pins, and found them work very well. He had such faith in the short roller bearings, that he had chosen them on occasion rather than the ball bearings, because he thought they would carry a higher load. Streibeck quite unintentionally led people astray at first, when he published a formula for a safe load for ball bearings, taking no account of the speed. A great many people commenced working upon that formula and at too high speeds, and the ball bearings failed. Whilst some of the makers' lists were distinctly too high, others were too low. Some of the ball bearings on the market would safely run on bigger loads and speeds than the makers gave. The success or failure of ball bearings depended enormously on accuracy of workmanship; nine-tenths of the failures had been due to rough-and-ready workmanship. With regard to the suggestion of cone roller bearings for taking end thrust, he did not think any bearing ought to be put to the double purpose; they ought to use two bearings, one to take the radial load and the other to take the end thrust. There were ball bearings on the market intended to take both, but he had never seen one which he considered to be a success. With regard to the overhung pinion on a tramway motor, he would not hesitate to put in a ball bearing there, provided it was not overloaded. He was talking to a chief railway engineer the other day, and said, "Why don't you put ball bearings on some of your rolling stock?" The reply was, "We have tried it, and it was too successful. If you put ball bearings on any of your rolling stock for goods traffic you must put them on all, because if you don't you will kill all your shunters. If you get one truck fitted with ball bearings and another not, the driver cannot judge the distance the truck is going to run." That was a point which had never occurred to him before; and it was a striking illustration of the way in which the practical man could teach things to a mere theorist.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendments.

FRANCE.—The French Customs authorities have decided that "locomobiles" driven by gas are to be dutiable as gas motors, according to kind, under No. 510 of the French tariff as follows:—

Weighing from 250 to 100,000 kg.	...	...	12 fr. per 100 kg.
„ less than 250 kg.	...	...	20 „

Bearings for the shafts of electric alternators are to be dutiable as detached parts of machines, at rates varying from 12 to 20 fr. per 100 kilograms according to weight. Speed reducers, whether or not imported at the same time as the machines with which they are to be connected, are also to be dutiable under this latter heading

HOLLAND.—With reference to the paragraph on page 727 of the Electrical Review of November 1st calling attention to a new tariff which it was proposed to put into force in Holland, the Board of Trade have now issued certain corrections to their original translation of the proposals. The details given in our extract require modification as follows, as a result of these corrections:—

Machine tools, boilers, pumps, &c., should read *prime movers*, boilers, pumps, &c.

Appliances (apparatus) not being *machine or hand tools*, not specially mentioned, should read appliances (apparatus) not being *prime movers or tools, machines or appliances for producing an alteration of form in some given material.*

The following headings should also be added to the extract we gave, immediately before "implements not separately mentioned":—

Other tools, machines and appliances not separately mentioned	Free
Parts of tools, machines and appliances:	
(*a*) In so far as they are recognisable as being parts of tools, machines or appliances exempt from duty	Free
(*b*) Other...	6 % ad val.

AUSTRALIAN COMMONWEALTH.—The Customs authorities have issued the following decisions as to the duties to be levied on certain electrical and similar goods on importation; the duty quoted is in every case the preferential rate applicable to British goods:—

Batteries, storage, imported with and for street tramway cars	35 %
Binders, made of round copper wire which has been flattened at each end	10 %
Switch case. A cast-iron case enclosing a switch and fuses only	Free
Switch case, as described above, when containing compensating or rheostatic equipment	20 %
Switch. Time. A clockwork apparatus to switch on or off at fixed intervals or at fixed times	Free
Tapes, for electrical purposes, being merely copper strips cut to length	Free
Magnetos for use in the manufacture of motor cycles, provided security be given that they will be incorporated in motor cycles manufactured in the Commonwealth, and that proof of such use be furnished to the satisfaction of the collector within six months after delivery, by the Customs	Free
Electrical stoves	10 % ad val.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

27,024. "Solenoid coil for alternating current arc lamps." Korting and Mathiesen Akt.-Ges. (Convention date, December 2nd, 1911, Germany.) November 25th. (Complete.)

27,046. "Live rails and collectors of electric roundabouts, scenic railways and the like." L. A. Hackett and E. W. Whattam. (Divided application on 28,899 of 1911, December 22nd.) November 25th.

27,049. "Electric lamp." J. J. Kelly, J. M. Doyle and A. Cohen. November 25th.

27,065. "Incandescent lampholders, ceiling roses, and like electrical fittings." E. B. Gray. November 25th.

27,069. "Regulation of electric installations and systems." Akt-Ges. Brown, Boveri et Cie. (Convention date, February 3rd, 1912, Germany.) November 25th. (Complete.)

27,090. "Automatic reverse current cut-outs." P. Ackerman. November 25th. (Complete.)

27,094. "Means for reducing the duration of sparks produced by magneto-electric generators." P. Mascow. (Convention date, January 25th, 1912, Germany.) November 25th. (Complete.)

27,160. "Lamp and shade holders for incandescent electric lamps." G. A. Collier. November 26th.

27,235. "Regulating mechanism for electric distribution systems." British Thomson-Houston Co., Ltd., E. Garton and A. H. St. C. Watson. November 26th.

27,236. "Electric control systems." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitats-Ges., Germany.) November 26th.

27,244. "Means for and methods of changing the frequency of alternating currents." A. M. Taylor. (Addition to 8,853, 1911.) November 27th.

27,246. "Armature for direct-current watt-hour electricity meters." H. E. Moul. (Körting & Mathiesen Akt.-Ges., Germany.) November 27th. (Complete.)

27,276. "Reflectors for electric incandescent lamps." C. Damey. November 27th. (Complete.)

27,325. "Electric lamp." C. W. Hillier. November 27th.

27,345. "Covering for telephone receivers and the like." E. M. Davies. November 28th.

27,348. "Electro-dynamometer instruments." J. T. Irwin. November 28th.

27,351. "Galvanic batteries." A. F. Hawdon. November 28th.

27,382. "Apparatus for winding up and starting of the number switches in automatic telephone subscribers' stations." Zivnostenska Banka v Praze (Firm of). (Convention date, November 28th, 1911, Austria.) November 28th. (Complete.)

27,403. "Short circulating device for the ignition mechanism of internal combustion engines." R. Bosch (Firm of). (Convention date, January 13th, 1912, Germany.) November 28th. (Complete.)

27,432. "Incandescent lamps." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitats Ges., Germany.) November 28th.

27,433. "Manufacture of filaments." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 28th.

27,442. "Manufacture of bodies of tungsten, with small additions of other metals, for use in electric incandescent lamps." Wolfram Lampen Akt.-Ges. (Convention date, June 3rd, 1912, Germany.) November 28th. (Complete.)

27,482. "Dynamo-electric brakes for electric motors." Etchells, Congdon and Muir, Ltd., and F. Muir. November 29th. (Complete.)

27,496. "Electric welding tool." E. H. Jones. November 29th.

27,500. "Apparatus for controlling electrical energy for lighting, heating and power purposes." A. I. Grabham. November 29th. (Complete.)

27,501. "Switchboards." C. A. Vandervell and A. H. Midgley. November 29th. (Complete.)

27,503. "Electric lampholders." M. J. Railing and J. H. Collings. November 29th.

27,504. "Electrical controlling devices for lifts." R. S. T. Henry. November 29th.

27,510. "Apparatus for use in forming joint ends on electrical conduits, drain pipes and the like." R. Lawton. November 29th. (Complete.)

27,526. "Electric arc lamps." British Thomson-Houston Co., Ltd., (General Electric Co., United States.) November 29th.

27,530. "Automatic electric circuit-breaking arrangements." E. O. Muller. (Divided application on 6,990/12 September 21st.) November 29th. (Complete.)

27,534. "Means for indicating when the flow of current in an electric circuit is interrupted or varied." A. F. Berry. November 29th.

27,535. "Methods of reducing the loss of energy in lines for variable electric currents." F. A. Becker. (Addition to 65, 1911.) November 29th. (Complete.)

27,563. "Controlling devices for electric motors." A. H. Curtis, A. H. Macley and Adams Manufacturing Co., Ltd. November 30th.

27,575. "Cords and weights of telephone switchboards." M. S. Conner. November 30th.

27,609. "Combined interrupter, commutator, and current reverser." L. L. Leduc. November 30th. (Complete.)

27,610. "Electro-magnetic bolts for locks." L. L. Leduc. November 30th. (Complete.)

27,612. "Method or process for utilising or re-energising exhausted electric dry cells." A. H. Mayes. November 30th.

27,620. "Means for communicating orders and information from one place to another." Eversheds & Vignoles, Ltd., and S. Eversheds. November 30th.

27,624. "Control of electric motors." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Ges., Germany.) November 30th.

27,633. "Electric batteries." W. H. Lowe. November 30th.

27,634. "Electrolytes." W. H. Lowe. November 30th.

27,651. "Production of insulating layers or coatings on electrical conductors." J. Loewenthal. November 30th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1911

Incandescent Electric Lamps. G. Ludecke and Brimsdown Lamp Works, Ltd. 27,268. December 5th.

Materials for Dynamo Brushes, Shaft and other Bearings. British Thomson-Houston Co. (General Electric Co.) 27,621. December 8th.

Combined Electrical Switch and Resistance or Current Graduating Device. Dimming Switches, Ltd., and W. L. Barber. 29,284. December 28th.

Apparatus for Lighting and Extinguishing Lights at Predetermined Times. J. Gunning. 24,'07. November 7th.

Apparatus for Automatically Maintaining a Uniform Load on the Prime Mover of an Alternating-Current Generating Set. Lancashire Dynamo and Motor Co. and H. C. Siddeley. 25,109. November 11th.

Electric Clocks. W. J. Blenheim. 25,244. November 13th.

Means for Pressing an Intensifying Screen against a Photographic Plate in X-Ray Apparatus. W. Otto. 25,328. November 14th.

Overhead Systems for Transmitting Electricity. J. Paul. 25,864. November 14th. (November 29th, 1910. Addition to 28,687, 1910.)

Couplings for Electric Mains or Wires on Railway Passenger Coaches and other Vehicles. J. Stone & Co., Ltd., and A. H. Darker. 25,377. November 14th.

Electric Resistances. J. A. Hirst and P. S. Brook. 27,189. December 5th.

1912.

Miners' Lamps. T. Heaton. 239. January 3rd.

Apparatus for Controlling Motion from a Distance, applicable more particularly to the Control of Searchlights or Projectors, Steering Gear and the like. Siemens Schuckertwerke. 956. January 12th. (September 28th, 1911.)

Automatic Tension Regulators for Shunt Dynamos. J. Gallay. 1,539. January 19th.

Telephones. F. C. Shardlow. 1,721. January 22nd.

Protected Electric Fuse Blocks. W. F. Price and Callender's Cable and Construction Co. 2,380. January 30th.

Method of Supporting the Commutators of Dynamo-Electric Machines. A. W. Jones. 3,282. February 9th.

Continuity of Electric Conduit Systems. M. J. Railing and T. Taylor. 3,479. February 12th.

Impulse Transmitter for Automatic Telephone Systems. M. Baum. 6,905. March 15th. (March 18th, 1911.)

Selective Electric Signalling on Telephone Exchange Party Lines. G. H. Crook. 6,640. March 18th.

Lamp Pillars for Electric Lighting. J. Southall. 7,056. March 22nd.

Electric Apparatus for Recording the Discharge of Materials from Wagons. J. Wasgestian. 7,889. April 1st.

Apparatus for Phonographically Recording Telephonically-transmitted Conversations. Walseck & Starcke (Firm of). 9,751. April 24th. (October 30th, 1911.)

Apparatus for Phonographically Recording Telephonically-transmitted Conversations. Walseck & Starcke (Firm of). 9,752. April 24th. (November 25th, 1911.)

Impulse Transmitter for Semi-automatic Telephone Systems. Siemens and Halske Akt.-Ges. 10,444. May 2nd. (May 2nd, 1911.)

Impulse Transmitters for Semi-automatic Telephone Systems. Siemens and Halske Akt.-Ges. 11,464. May 14th. (May 16th, 1911.) (Addition to No. 10,444, 1912.)

Apparatus for the Operation of Electrical Clocks by Electric Waves. F. Schneider. 12,680. May 29th. (Divided application on No. 3,966, 1912. February 16th.)

Devices for Protecting Telegraph and like Lines against Inductive Action from Neighbouring Circuits. O. Moll and P. Kuschewitz. 12,764. May 30th.

Combined Electric Lamp and Magnetic Compass. H. Neuburger. 13,001. June 3rd.